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Lin et al.

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(54) **USER INTERFACE FOR CONTROL OF A DISPLAY DEVICE**

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(73) Assignee: **Trident Microsystems, Inc.**, Sunnyvale, CA (US)

(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(22) Filed: **Nov. 18, 1999**

(51) **Int. Cl.**[7] **G06F 13/00**
(52) **U.S. Cl.** **345/810**; 345/145
(58) **Field of Search** 345/127, 128, 345/131, 132, 114, 115, 145, 146, 762, 765, 744, 764

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,874,962 A	*	2/1999	De Judicibus et al.	345/781
5,986,638 A	*	11/1999	Cheng	345/145
6,266,042 B1	*	7/2001	Aratani	345/132

* cited by examiner

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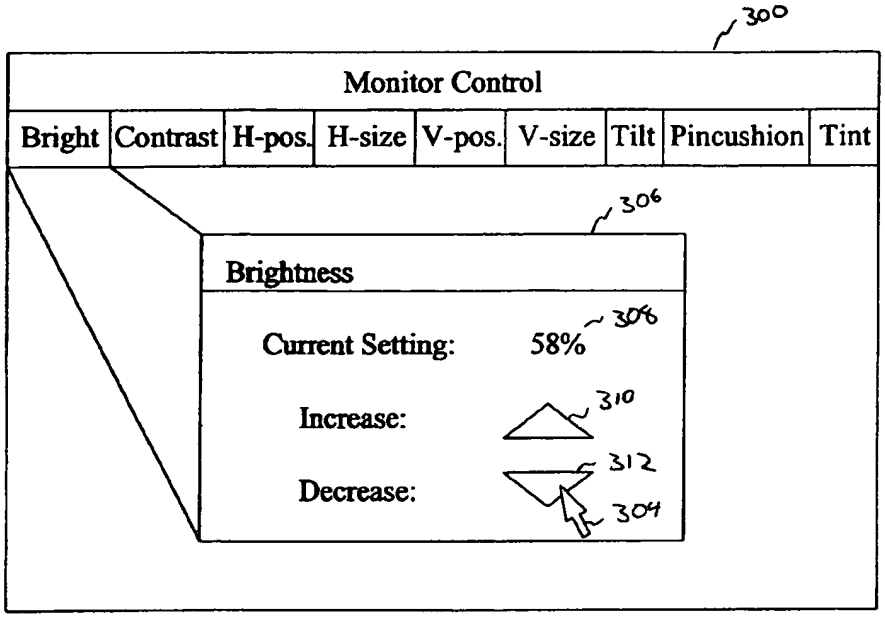
(57) **ABSTRACT**

A method and apparatus provide a user interface for control of a display device. A video signal is provided to a display device and a graphic image is displayed by the display device. The video signal may be provided to the display device by a host computer system coupled to the display device. Input to the host computer system is received by a user manipulating the graphic image via an input device. The host computer system responds to the input by communicating a command to the display device, the command for adjusting a parameter of the display device. The parameter may be selected from a group consisting of: brightness, contrast, horizontal orientation, horizontal size, vertical orientation, vertical size, tilt, pincushion, and color tint for the display. The command may be communicated via a data sequence sent to the display device by the host computer system. The data sequence may be encoded onto the video signal sent to the display device by the host computer system. The command may be communicated via a digital protocol which provides for bi-directional communication. The input device may be one or more of: a cursor control device coupled to the computer system; and a keyboard coupled to the computer system. The graphic image may include one or more of: a task window which provides a graphic menu; a graphic representation of the parameter, the graphic representation changing in response to said input by the user; a sliding scale; and a numeric value.

43 Claims, 6 Drawing Sheets



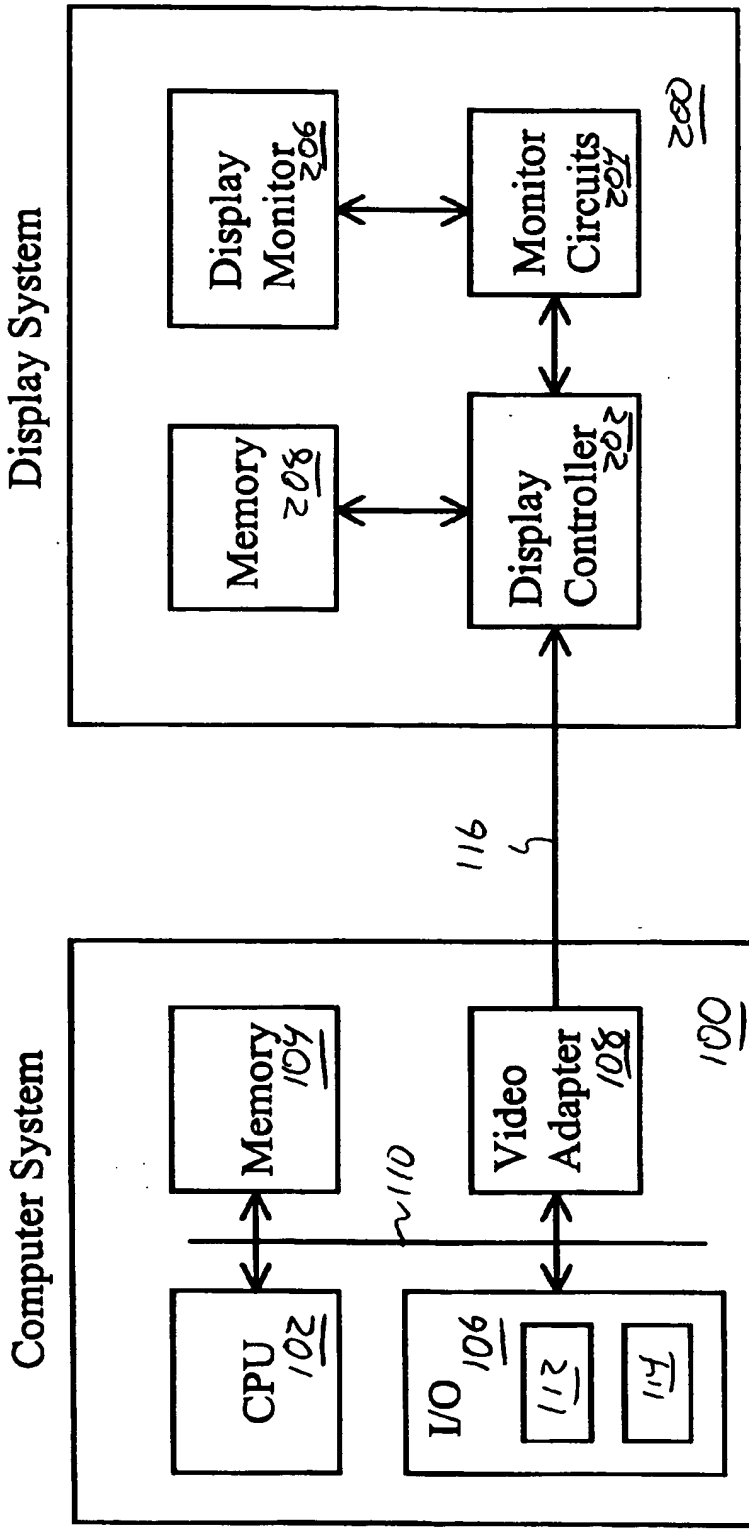

Display System
Display Monitor 206
Monitor Circuits 204
200
Memory 208
Display Controller 202
116
Computer System
Memory 104
Video Adapter 108
100
110
CPU 102
I/O 106
112
114

Figure 1

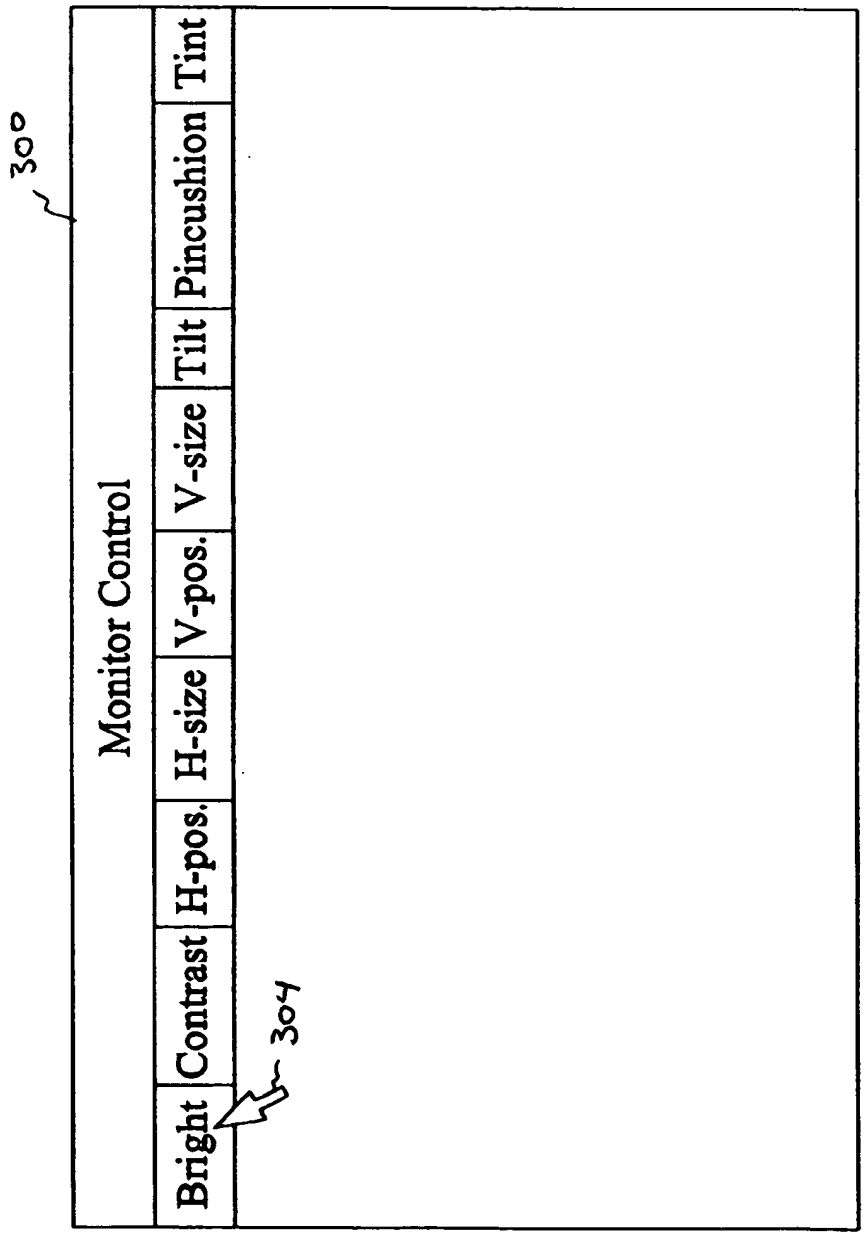

300
Monitor Control
Bright
Contrast
H-pos.
H-size
V-pos.
V-size
Tilt
Pincushion
Tint
304
302

Figure 2

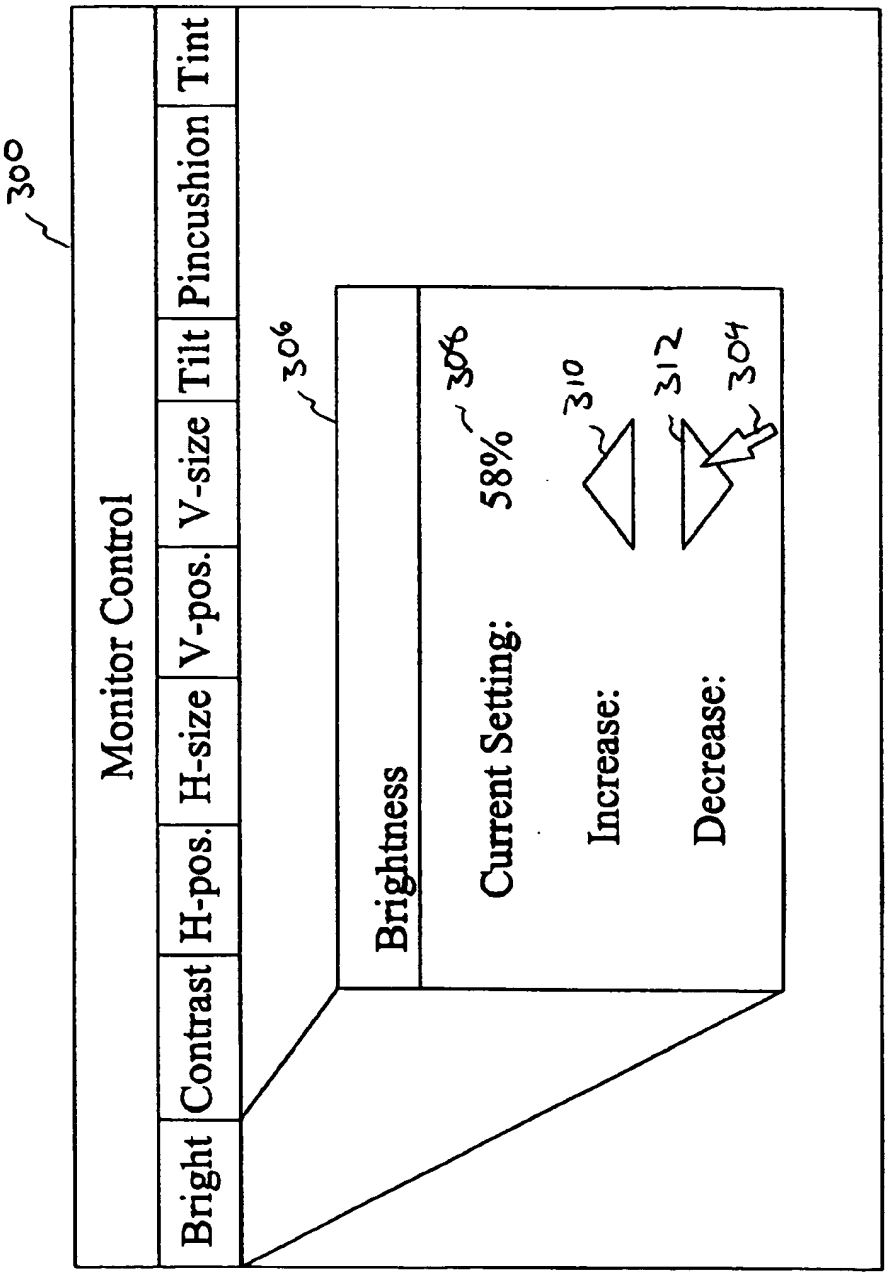

300
Monitor Control
Bright
Contrast
H-pos.
H-size
V-pos.
V-size
Tilt
Pincushion
Tint
306
Brightness
Current Setting:
58%
306
310
Increase:
312
Decrease:
304

Figure 3

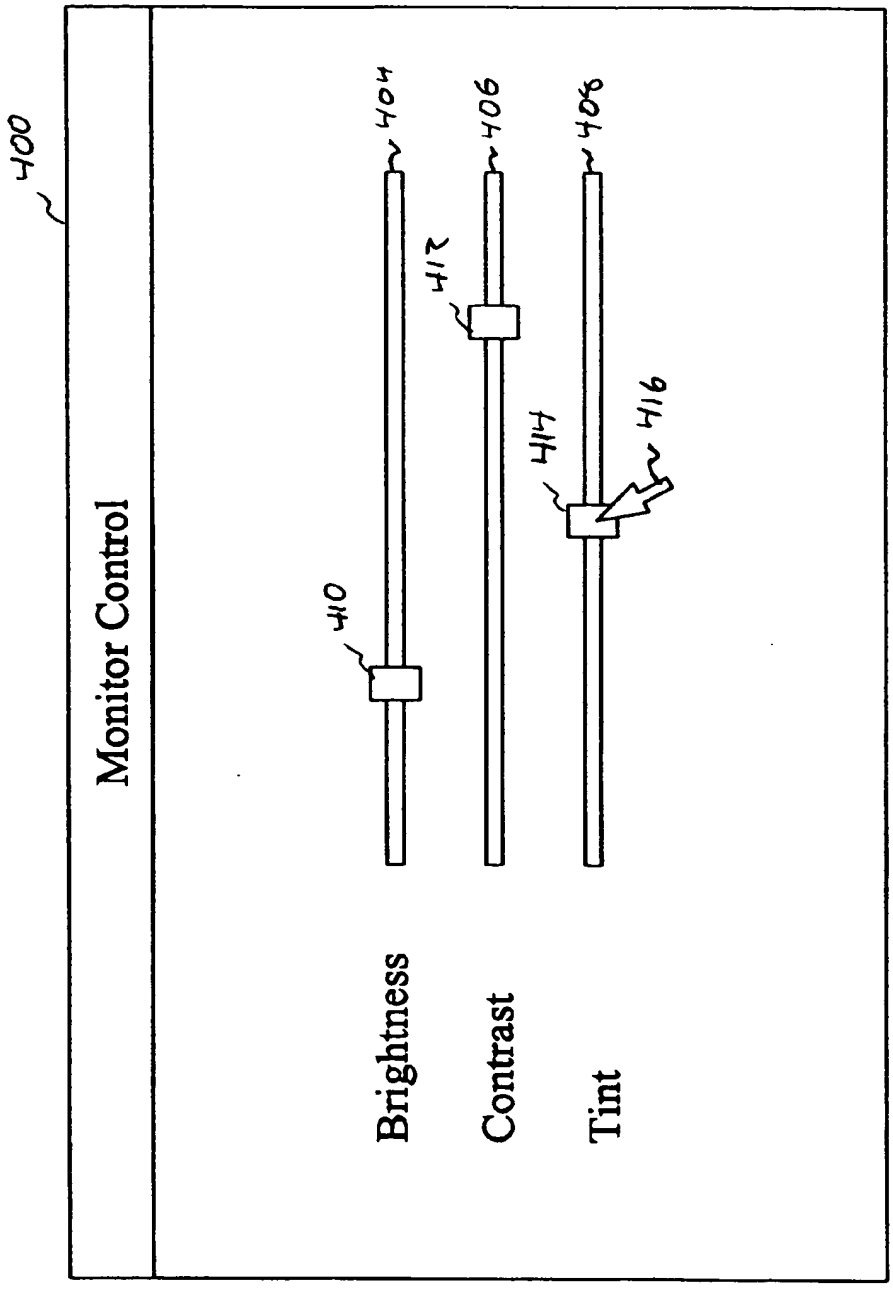

400
402
Monitor Control
404
406
408
410
412
414
416
Brightness
Contrast
Tint

Figure 4

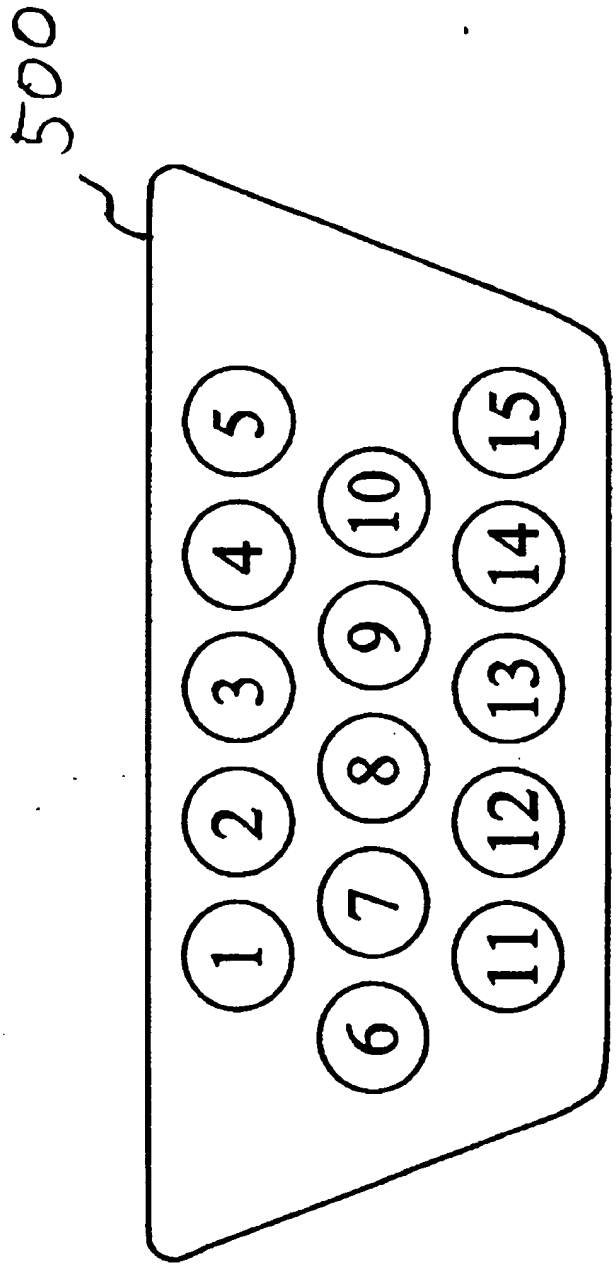


Figure 5

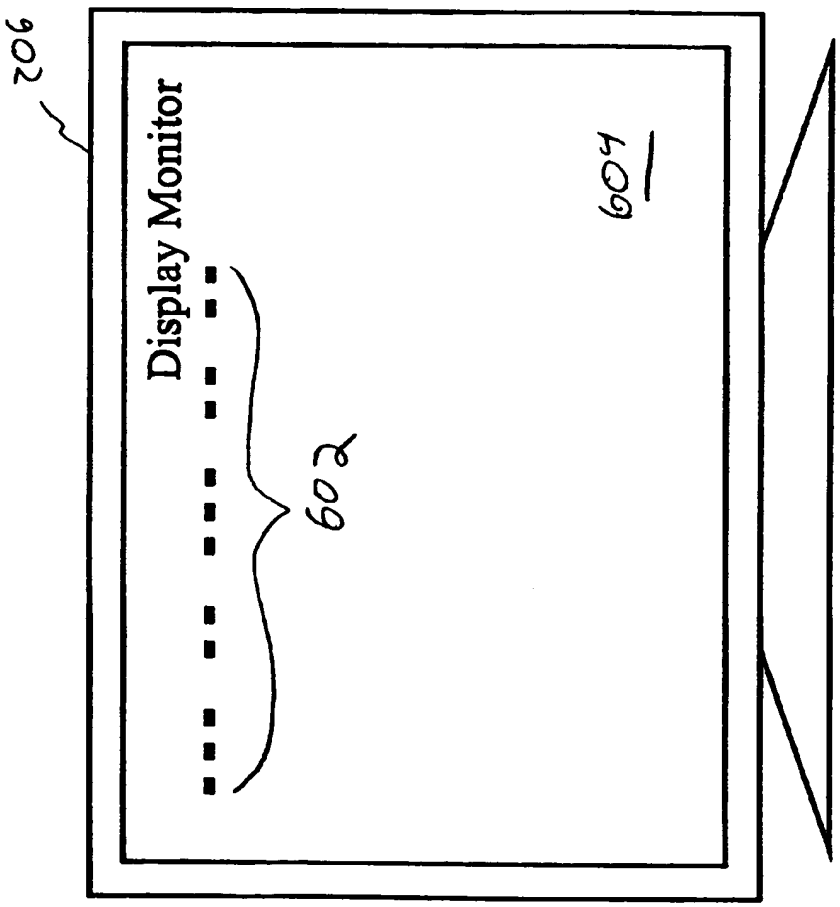


Figure 6

USER INTERFACE FOR CONTROL OF A DISPLAY DEVICE

BACKGROUND OF THE INVENTION

The present invention relates to the field of display devices. More particularly, the present invention relates to the field of control of a display device via a user interface.

Conventionally, a computer system provides video signals to a display device associated with the computer system. A user interface is typically provided to adjust parameters for the display device, such as brightness, contrast, horizontal orientation, horizontal size, vertical orientation, vertical size, tilt, pincushion, and color tint. The user interface is typically provided by the display device and includes controls located directly on a housing for the display device which can be used to adjust the display parameters. The controls are typically rheostat dials or push-button switches which are located at the bottom or side of the display housing and connected to circuitry located within the display housing.

In the case of push-buttons, the circuitry within the display housing typically includes an on-screen display circuit (OSD). The OSD receives input from the push-buttons and, in response, generates graphics and text which overlay any image provided on the display screen by the computer system. The various parameters for the display device are selected and adjusted by further pressing of the push-buttons. To minimize its cost, the OSD typically has limited processing capacity and speed. As a result, the graphics and text provided by the OSD tend to be of relatively low resolution. In addition, the number of push-button switches is typically limited for aesthetic purposes and to minimize their cost. As a result, each push-button may be assigned multiple functions. This, however, requires that the push-buttons be manipulated in specific sequences to perform the adjustments. Accordingly, conventional user interfaces provided to adjust the parameters of a display device tend to be confusing to use.

Parameters relating to the video signals themselves are typically adjusted through a user interface provided by the computer system. Parameters adjusted by this interface may include, for example, a delay time for invoking screen-saver graphics, a number of bits to be utilized for representing various colors (e.g., the color palette), display area and monitor type. This user interface provided by the computer system is in addition to, and separate from, the user interface provided by the display device.

The user interface provided by the computer system is typically accessed through the computer system's "control panel." When the "control panel" is invoked by a user, the computer system provides the user interface by which the user may adjust parameters for the video signals. This is generally accomplished by the user manipulating graphic elements displayed on the display device via input from the user which is typically provided by a keyboard or mouse. This user interface, however, only affects the video signals provided by the computer system and does not provide an ability to adjust any parameters of the display device.

Therefore, what is needed is a user interface for controlling a display device and for adjusting display parameters which does not suffer from the drawbacks of prior user interfaces. It is this end that the present invention is directed.

SUMMARY OF THE INVENTION

The present invention provides a user interface for control of a display device. The invention provides improved graphics to be displayed by the display device for use in making adjustments to parameters of the display device without significant increases in cost. Rather, because the graphics for the user interface may be provided to the display device by a computer system coupled to the display device, an on-screen display circuit (OSD) may be omitted from the display device. Further, the invention allows parameters for the display device to be adjusted by a user manipulating graphic elements via an input device for the computer system, such as a keyboard or mouse. Thus, the invention provides that rheostat dials or push-button switches may be omitted from the display device. Accordingly, the present invention provides a user interface having improved graphics and lower cost and which is less confusing to use than conventional user interfaces.

In one aspect, a method and apparatus provide a user interface for control of a display device. A video signal is provided to a display device and a graphic image is displayed by the display device. The video signal may be provided to the display device by a host computer system coupled to the display device. Input to the host computer system is received by a user manipulating the graphic image via an input device. The host computer system responds to the input by communicating a command to the display device. The command is for adjusting a parameter of the display device.

In another aspect, a display device is provided including a display monitor and a display controller coupled to the display monitor. The display monitor displays a graphic image provided to the display monitor by a host computer system. The display controller receives a command from the host computer system for adjusting a parameter of the display monitor, where the command is in response to input to the host computer system from a user. The input to the host computer may be by the user manipulating the graphic image via the host computer.

The graphic image may include one or more of: a task window which provides a graphic menu; a graphic representation of the parameter, the graphic representation changing in response to said input by the user; a sliding scale; and a numeric value. The command may be communicated via a data sequence sent to the display device by the host computer system. The data sequence may be encoded onto the video signal, the video signal being sent to the display device by the host computer system. The command may be communicated via a digital protocol which provides for uni-directional communication from the host computer system to the display device. Further, the command may be communicated via a digital protocol which provides for bi-directional communication. The digital protocol may be an I^2C protocol. The command may be communicated to the display device via a DCC2B interface. The input device may be one or more of: a cursor control device coupled to the computer system; and a keyboard coupled to the computer system. The parameter may be selected from a group consisting of: brightness, contrast, horizontal orientation, horizontal size, vertical orientation, vertical size, tilt, pincushion, and color tint for the display.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a block diagram of a host computer system and a display system in accordance with the present invention;

FIG. 2 illustrates a first task window provided for selecting a parameter for a display monitor;

FIG. 3 illustrates a second task window provided for adjusting a selected parameter for the display monitor;

FIG. 4 illustrates a third task window provided for selecting and adjusting a parameter for the display monitor;

FIG. 5 illustrates a connector for interfacing the host computer system and the display system of FIG. 1; and

FIG. 6 illustrates an image for the display system including features for communicating digital data from the host computer system the display system.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 illustrates a block diagram of a host computer system **100** driving a display device **200** in accordance with the present invention. The host computer system **100** may include a central processing unit (CPU) **102**, a memory **104**, input/output (I/O) devices **106** and a video adapter **108**, all of which are interconnected by a system bus **110**. The memory **104** is conventional and may include random access memory (RAM), read only memory (ROM), a hard disk, a removable media, such as a floppy disk, magnetic tape or optical disk, or other memory device. The I/O devices **106** are conventional and may include a keyboard **112**, a cursor control device **114** (e.g., a mouse), a network interface card, a modem, a display monitor, or a printer. It will be apparent that the computer system **100** is conventional and that the particular configuration of the computer system **100** illustrated in FIG. **1** is exemplary.

Data representative of an image to be displayed is typically generated by an application or other program stored in the memory **104** and executed by the CPU **102**. The image data may be provided to the video adapter **108** via the system bus **110**. The computer system **100** may be coupled to the display system **200** via the video adapter **108** and a video interface **116**. The video adapter **106** typically forms video signals which are appropriate for driving the display system **200**. The video signals may include red (R), green (G), blue (B), horizontal sync and vertical sync. Alternately, the video signals may be in another format, such as composite video or luminance-chrominance (Y-C) component video. The video interface **116** provides the video signals to the display system **200** and may also provide other signals for control of the display system **200**, as explained herein.

As shown in FIG. **1**, the display system **200** may include a display controller **202**, monitor circuits **204**, a display monitor **206** and a memory **208**. The display controller **202** may receive the video signals from the computer system **100** and, if necessary, may convert them into form suitable for provision to the monitor circuits **204**. The monitor circuits **204** may provide driving signals and control signals for the display monitor **206**. For example, assume that the video signals are analog and that the display monitor **206** is a digital display (e.g., a flat panel display). In which case, the display controller **202** may sample the analog signals to form digital samples, while the monitor circuits **204** may receive the digital samples from the display controller **202** and may provide them to the display monitor **206** at an appropriate rate. The memory **208** may include a frame buffer for temporarily storing video data to be displayed by the display monitor **206**. Assuming, however, that the display monitor **206** is an analog display (e.g., a cathode ray tube monitor), then the display controller **202** may receive the analog video signals and may perform analog processing on the video signals, if necessary. The display controller **202** may then provide the processed video signals to the monitor circuits **204**.

By providing driving signals and control signals to the display monitor **206**, the monitor circuits **204** may provide an ability to adjust brightness, contrast, horizontal orientation, horizontal size, vertical orientation, vertical size, tilt, pincushion, color tint and other display parameters for the display monitor **206**. These settings may be stored in the memory **208**. Alternately, rather than being provided by the monitor circuits **204**, an ability to adjust one or more of these parameters may be provided by the display controller **202** or the display monitor **206**.

To adjust the display parameters for the monitor **206**, the invention provides a display control user interface. The computer system **100** may include a stored software program for implementing this user interface. The user interface software program may be stored in the memory **104** and executed by the CPU **102** when invoked by a user. For example, the interface software may be invoked by the user double-clicking on an appropriate icon displayed by the display monitor **206**. Alternately, the user may invoke the user interface software by accessing a "control panel" software program provided by the computer system **100**.

Upon commencing execution, the display control user interface software program may cause the computer system **100** to generate video signals which represent a graphic interface for display by the display monitor **206**. For example, the graphic interface may include a task window displayed by the display monitor **206**.

FIG. **2** illustrates an exemplary task window **300** which may be displayed by the display monitor **206** (FIG. **1**) for making adjustments to display parameters for the monitor **206**. As shown in FIG. **2**, the task window **300** may be displayed within a display area **302** or "desktop" of the display monitor **206**. The task window **300** may include a menu of parameters which may be adjusted through the user interface. For example, and as shown in FIG. **2**, the menu may include: "Bright," for adjusting brightness; "Contrast," for adjusting contrast; "H-pos," for adjusting horizontal position, "H-size," for adjusting horizontal size; "V-pos," for adjusting vertical position, "V-size," for adjusting vertical size; "Tilt," for adjusting tilt orientation of the display image; "Pincushion," for pincushion adjustments for the display; and "Tint," for adjusting color tint for the display. It will be apparent that the arrangement of display parameters shown in FIG. **2** is exemplary and that more, fewer or different display parameters may be selected for adjustment via the user interface.

The user may then select one or more of the display parameters for adjustment. Preferably, this is accomplished by the user providing input to the computer system **100** (FIG. **1**), such as by manipulating graphic elements provided by the task window **300** via the computer mouse **114** or keyboard **112**. For example, assuming the user wishes to make an adjustment to the brightness setting, the user may position a cursor **304** over the "Bright" menu item and, then, may select the menu item by pressing a button on the mouse **114**. Alternately, the user may select the "Bright" menu item by appropriately manipulating the keyboard **112** of the computer system **100**.

Once a parameter is selected for adjustment via the user interface, the parameter may then be adjusted by further manipulation of graphic elements. FIG. **3** illustrates the window of FIG. **2** after the brightness adjustment has been selected. As shown in FIG. **3**, another task window **306**, specific to the selected parameter, may be displayed along with the task window **300**. The task window **306** of the user interface may display a field **308** in which a current level for the brightness setting (e.g., 58%) is displayed. In addition, graphic elements, such as an upwardly oriented arrow **310**

and a downwardly oriented arrow **312**, may be displayed. By using the mouse **114** (FIG. 1) or keyboard **114** (FIG. 1) to select the upwardly oriented arrow **310**, the brightness level may be increased, while by selecting the downwardly oriented arrow **312**, the brightness level may be decreased. As shown in FIG. 3, the cursor **304** is positioned so as to select the downwardly oriented arrow **312**; pressing a button on the mouse **114** (FIG. 1) causes the brightness level to be decreased. Assuming a level for the parameter is displayed, such as in the field **308**, the displayed level is preferably updated by the computer system **100** when the level is changed.

It will be apparent that a task window similar to the task window **306** may be provided for each parameter for the display monitor **206** that to be adjustable by the user interface. Alternately, different task window may be provided for each display parameter that is adjustable. In addition, it will be apparent that the particular graphics displayed for the interface may be varied from that shown in FIG. 3.

FIG. 4 illustrates an alternate task window **400** which may be displayed by the display monitor **206** (FIG. 1) for making adjustments to parameters for the display monitor **206**. As shown in FIG. 4, the task window **400** is displayed within a display area **402** or "desktop" of the display monitor **206**. The task window **400** may include a displayed selection of parameters along with slide scales **404–408**. For each slide scale **404–408**, a respective slider **410–414** is also provided which indicates a current setting for the corresponding display parameter. For example, and as shown in FIG. 4, the parameters may include: "Brightness," for adjusting brightness; "Contrast," for adjusting contrast; and "Tint," for adjusting color tint for the monitor **204**. It will be apparent, however, that other display parameters may be included within the task window **400**. To adjust a parameter via the task window **400** of FIG. 4, the user may manipulate the graphic image displayed by the task window **400**. This may be accomplished by the user manipulating the computer mouse **114** to position a cursor **416** over one of the sliders **410–414** which corresponds to the selected parameter. As shown in FIG. 4, the cursor **414** is positioned over the slider **416**. Then, the user may hold down a button of the mouse to "drag" the slider **414** to a new position on the corresponding slide scale **408**.

Thus, referring again to FIG. 1, the computer system **100** provides video signals to the display system **200** to display a graphic user interface on the display monitor **206** for adjusting display parameters. A user provides input the computer system **100** by manipulating the graphic interface, such as with the mouse **114** or keyboard **112**, to select and adjust the display parameters.

Then, according to the present invention, in response to the user's input, the computer system **100** may communicate to the display system **200**, via the interface **116**, the changes to be made to the display parameters. This communication may be accomplished by the interface **116** operating in accordance with a uni-directional protocol for communication from the computer system **100** to the display device **200** or in accordance with a bi-directional protocol. The interface **116** may be a standard interface defined by the Video Electronics Standards Association (VESA). For example, a conventional display data channel interface, known as DCC2B, provides video signals to a display device and also provides bi-directional communication between a host computer system and the display device. FIG. **5** illustrates a connector **500** for implementing the interface **116** in accordance with DCC2B.

The connector **500** may include a plurality of pins numbered 1–15 in FIG. 5. Pin 1 may communicate a red component video signal from the computer system **100** (FIG. 1) to the display system **200** (FIG. 2); Pin 2 may communicate a green component video signal from the computer system **100** to the display system **200**; Pin 3 may communicate a blue component video signal from the computer system **100** to the display system **200**; Pin 4 may be reserved; Pin 5 may provide a ground reference; Pin 6 may be a ground reference for the red component video signal; Pin 7 may be a ground reference for the green component video signal; Pin 8 may be a ground reference for the blue component video signal; Pin 9 may provide a 5.0 volt reference level from the computer system **100**; Pin 10 may provide a ground reference for sync signals; Pin 11 may optionally provide a monitor identification from the display system **200** to the computer system **100**; Pin 12 may provide a serial data link for bidirectional communication between the computer system **100** and the display system **200**; Pin 13 may provide a horizontal sync or composite sync from the computer system **100** to the display system **200**; Pin 14 may provide a vertical sync from the computer system **100** to the display system **200**; Pin 15 may provide a clock signal which is synchronous with data sent via Pin 12 for synchronizing the computer system **100** or the display system **200** to data sent by the other via Pin 12. Data may be communicated via the Pins 12 and 15 in accordance with I^2C, which is a protocol for bi-directional communication via a serial data line (SDA) and a serial clock line (SCL).

Alternately, the interface **116** may be in accordance with an non-standardized interface (e.g., an interface other than DCC2B) which provides for communication of data from the computer system **100** to the display monitor **200** in addition to the communication of video signals. Such an interface may operate in accordance with the I^2C protocol, or another protocol. In addition, such an interface may utilize a connector other than that shown in FIG. **5** and having alternate pin assignments. In which case, the data communicated from the computer system **100** to the display system **200** may result in changes to display parameters.

Further, data may be communicated from the computer system **100** to the display system **200** by encoding the data onto one or more of the signal lines for the red, green and blue video signals (e.g., a data sequence may be encoded onto one or more of video signals utilizing amplitude modulation). In which case, the display controller **202** (FIG. 1) may detect and identify the data sequence by digital sampling of the appropriate one or more of the red, green and blue signal lines. FIG. **6** illustrates an image for the display monitor **206** (FIG. 1) including features **602** for communicating digital data from the host computer system **100** to the display controller **202** in accordance with the present invention. As shown in FIG. **6**, the features **602** form a unique pattern (i.e., a data sequence) which is distinguished from background **604** by contrast. It will be apparent that the pattern shown in FIG. **6** is exemplary and that one or more different data sequences may be utilized.

Though the features **702** are displayed by the display monitor **206** in FIG. **6**, the data sequence is obtained by the display controller **202** from one or more of the analog video signals. Accordingly, it is not necessary that the features **602** actually appear on the display monitor **206**. Rather, the display controller **202** may be conditioned to prevent them from appearing on the display monitor **206**. Similarly, the features **602** need only be present in one of the RGB signals to be detected by the display controller **202**, though the features **602** may be present in two or three of the RGB signals.

For detecting the features **702**, the features **702** may be provided beginning at a predetermined time interval after a pulse in a horizontal signal provided to the display system **200** by the display controller **100** and may be outside of horizontal and vertical blanking intervals.

Thus, data may be communicated from the host computer system **100** to the display system **200** via the interface **116**. Once a particular data sequence is identified by the display controller **202**, the display controller **202** may respond by adjusting a display parameter identified by the particular sequence. The manner in which the parameter for the display monitor **206** is to be adjusted may also be identified by the data sequence. Accordingly, the display system **200** treats the data sequences as commands. For example, a particular data sequence may command the display system **200** to set a brightness level to 59 percent. As another example, a particular data sequence may command the display system to increase the brightness level by one percent from its current level. The adjustment may then be accomplished by the display controller **202** appropriately configuring the monitor circuits **204**. Thus, assuming the brightness level is to be adjusted, the monitor circuits may be conditioned to provide an adjusted voltage level to the display monitor **206** which results in an appropriate adjustment to the brightness level of the monitor **206**.

As mentioned, the data may be communicated via the interface **116** (FIG. 1) bi-directionally. For example, the DCC2B interface provides for bi-directional communication. In which case, the display controller **202** preferably returns an acknowledgement in response to successfully receiving a data sequence from the computer system **100**. Alternately, the data may be communicated uni-directionally from the computer system **100** to the display monitor **200**. For example, encoding of data sequences onto the red, green or blue video signal may provide uni-directional communication of the data sequences. In which case, the computer system **100** may not receive a acknowledgement.

From the foregoing, it should be apparent that the present invention provides an improved a user interface for adjusting parameters of a display monitor. Improvements over conventional techniques include improved graphics, lower cost and ease of use.

While the foregoing has been with reference to particular embodiments of the invention, it will be appreciated by those skilled in the art that changes in these embodiments may be made without departing from the principles and spirit of the invention, the scope of which is defined by the appended claims.

What is claimed is:

1. A method of providing a user interface for controlling a parameter of a display device comprising:

providing a video signal to a display device from a host computer, the video signal being adapted to cause the display device to display graphic images;

displaying a graphic image by the display device in response to the video signal received from the host computer, the graphic image being adapted to allow a user to visually adjust a parameter of the display device;

receiving input to the host computer system by a user manipulating the graphic image via an input device; and

responding to the input by the host computer system communicating a command signal to the display device, the command signal for adjusting the parameter of the display device.

2. The method according to claim **1**, said graphic image including a task window which provides a graphic menu.

3. The method according to claim **1**, said graphic image including a graphic representation of the parameter, the graphic representation changing in response to said input by the user.

4. The method according to claim **3**, said graphic representation including a sliding scale.

5. The method according to claim **3**, said graphic representation including a numeric value.

6. The method according to claim **1**, said command signal being communicated via a data sequence sent to the display device by the host computer system.

7. The method according to claim **6**, said data sequence being encoded onto the video signal, the video signal being sent to the display device by the host computer system.

8. The method according to claim **1**, said command signal being communicated via a digital protocol which provides for uni-directional communication.

9. The method according to claim **1**, said command signal being communicated via a digital protocol which provides for bi-directional communication.

10. The method according to claim **9**, said digital protocol being an I^2C protocol.

11. The method according to claim **1**, said command signal being communicated to the display device via a DCC2B interface.

12. The method according to claim **1**, said input device being a cursor control device coupled to the computer system.

13. The method according to claim **1**, said input device being a keyboard coupled to the computer system.

14. The method according to claim **1**, said parameter being selected from a group consisting of: brightness, contrast, horizontal orientation, horizontal size, vertical orientation, vertical size, tilt, pincushion, and color tint for the display.

15. An apparatus for providing a user interface for controlling a parameter of a display device comprising:

a display device for receiving a video signal for displaying graphic images in response to the video signal; and

a host computer system coupled to the display device for providing the video signal, for causing the display device to display a graphic image for adjusting a parameter of the display device, and for receiving input by a user manipulating the graphic image via an input device coupled to the host computer system, the host computer system communicating a command signal to the display device for adjusting the parameter of the display device in response to the input.

16. The apparatus according to claim **15**, said graphic image including a task window which provides a graphic menu.

17. The apparatus according to claim **15**, said graphic image including a graphic representation of the parameter, the graphic representation changing in response to said input by the user.

18. The apparatus according to claim **17**, said graphic representation including a sliding scale.

19. The apparatus according to claim **17**, said graphic representation including a numeric value.

20. The apparatus according to claim **15**, said command signal being communicated via a data sequence sent to the display device by the host computer system.

21. The apparatus according to claim **15**, said data sequence being encoded onto the video signal sent to the display device by the host computer system.

22. The apparatus according to claim 15, said command signal being communicated via a digital protocol which provides for uni-directional communication.

23. The apparatus according to claim 15, said command signal being communicated via a digital protocol which provides for bi-directional communication.

24. The apparatus according to claim 23, said digital protocol being an I^2C protocol.

25. The apparatus according to claim 15, said command signal being communicated to the display device via a DCC2B interface.

26. The apparatus according to claim 15, said input device being a cursor control device coupled to the computer system.

27. The apparatus according to claim 15, said input device being a keyboard coupled to the computer system.

28. The apparatus according to claim 15, said parameter being selected from a group consisting of: brightness, contrast, horizontal orientation, horizontal size, vertical orientation, vertical size, tilt, pincushion, and color tint for the display.

29. A display device comprising:

a display monitor for displaying graphic images in response to video signals provided to the display monitor by a host computer system, including a graphic image for adjusting a parameter of the display monitor; and

a display controller coupled to the display monitor for receiving a command signal from the host computer system for adjusting a parameter of the display monitor, said command signal being in response to input to the host computer system from a user.

30. The display device according to claim 29, said input to the host computer being by the user manipulating the graphic image via the host computer.

31. The display device according to claim 30, said graphic image including a task window which provides a graphic menu.

32. The display device according to claim 30, said graphic image including a graphic representation of the parameter, the graphic representation changing in response to said input by the user.

33. The display device according to claim 32, said graphic representation including a sliding scale.

34. The display device according to claim 32, said graphic representation including a numeric value.

35. The display device according to claim 29, said command signal being communicated via a data sequence sent to the display device by the host computer system.

36. The display device according to claim 35, said data sequence being encoded onto the video signal, the video signal being sent to the display device by the host computer system.

37. The display device according to claim 29, said command signal being communicated via a digital protocol which provides for uni-directional communication.

38. The display device according to claim 29, said command signal being communicated via a digital protocol which provides for bi-directional communication.

39. The display device according to claim 38, said digital protocol being an I^2C protocol.

40. The display device according to claim 29, said command signal being communicated to the display device via a DCC2B interface.

41. The display device according to claim 29, said input device being a cursor control device coupled to the computer system.

42. The display device according to claim 29, said input device being a keyboard coupled to the computer system.

43. The display device according to claim 29, said parameter being selected from a group consisting of: brightness, contrast, horizontal orientation, horizontal size, vertical orientation, vertical size, tilt, pincushion, and color tint for the display.

* * * * *

US005963269A

United States Patent [19]

Beery

[11] Patent Number: 5,963,269

[45] Date of Patent: *Oct. 5, 1999

[54] **APPARATUS FOR CONTROLLING A TELEVISION RECEIVER USING A PLURALITY OF STORED LABELS**

[76] Inventor: **Jack Beery**, 1550 Cedar Bark Trail, Unit 1, Dayton, Ohio 45449

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **08/482,940**

[22] Filed: **Jun. 7, 1995**

[51] **Int. Cl.**[6] **H04N 5/50**

[52] **U.S. Cl.** **348/570**; 348/731; 348/734; 455/186.1

[58] **Field of Search** 455/5.1, 6.1, 4.2, 455/3.1, 151.4, 182.2; 348/731, 732, 734; 340/825.22, 825.72, 825.03; 359/146

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,228,541	10/1980	Snedkerund et al.	455/158
4,361,907	11/1982	Wine	455/160
4,375,651	3/1983	Templin et al.	358/191.1
4,425,579	1/1984	Merrell	358/86
4,495,654	1/1985	Deiss	455/151
4,521,914	6/1985	Petrovic	455/158
4,527,194	7/1985	Sirazi	358/86
4,600,918	7/1986	Belisomi et al.	340/711
4,706,121	11/1987	Young	358/142
4,763,195	8/1988	Tults	358/193.1
4,894,714	1/1990	Christis	358/86
4,914,517	4/1990	Duffield	358/191.1
4,977,455	12/1990	Young	358/142
4,998,292	3/1991	Eigeldinger et al.	455/186
5,045,947	9/1991	Beery	358/192.1
5,068,734	11/1991	Beery	358/191.1
5,151,789	9/1992	Young	358/194.1
5,191,423	3/1993	Yoshida	348/734
5,253,067	10/1993	Chaney et al.	358/191.1
5,307,173	4/1994	Yuen	358/335
5,461,427	10/1995	Duffield	348/555

FOREIGN PATENT DOCUMENTS

58-13082	1/1983	Japan	H04N 5/44
58-172011	10/1983	Japan .	
61-61577	3/1986	Japan .	
63-36608	2/1988	Japan .	
63-59075	3/1988	Japan	H04N 5/44
2 021 887	12/1979	United Kingdom .	
2 083 722	3/1982	United Kingdom .	

OTHER PUBLICATIONS

Customer Handbook for Jerrold "Impulse 7000" Model DP71/DPV72/DPBB73 Addressable Converters (Jun. 1988).

"Experts Agree the TV of the future is here . . . in the Heathkit Digital–Design GR–2000 TV," magazine advertisement, source unknown, pp. 28–29.

Excerpt from "Operating Instructions" for Pioneer BA–6300 Series Converter (©1991).

Primary Examiner—Michael Lee

[57] **ABSTRACT**

Apparatus for controlling a television receiver includes a read-only memory for storing a plurality of labels, and a programmable memory for storing at least one channel number. An operator-actuated control generates a signal representative of one of the labels and a channel number to be associated therewith, and a processor receives the signal and causes the programmable memory to store the channel number as corresponding to the one label. The operator-actuated control further generates a second signal representative of the one label independent of the channel number. Upon receiving the second signal, the processor retrieves from the programmable memory the channel number and generates an output control signal corresponding to the channel number.

22 Claims, 14 Drawing Sheets

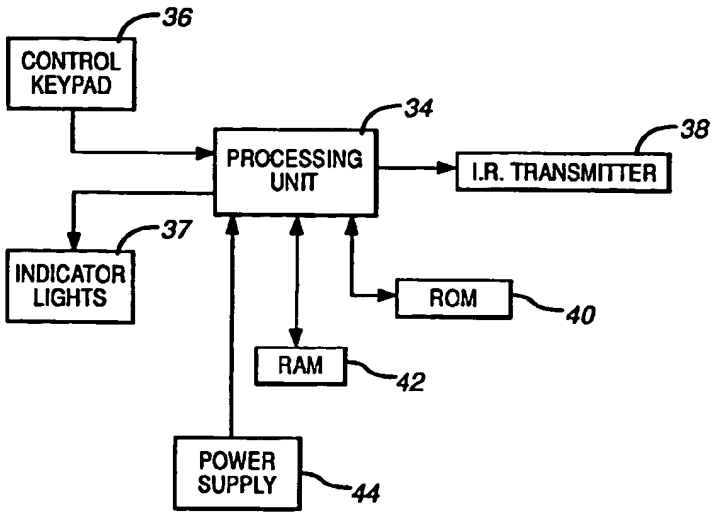


FIG. 1

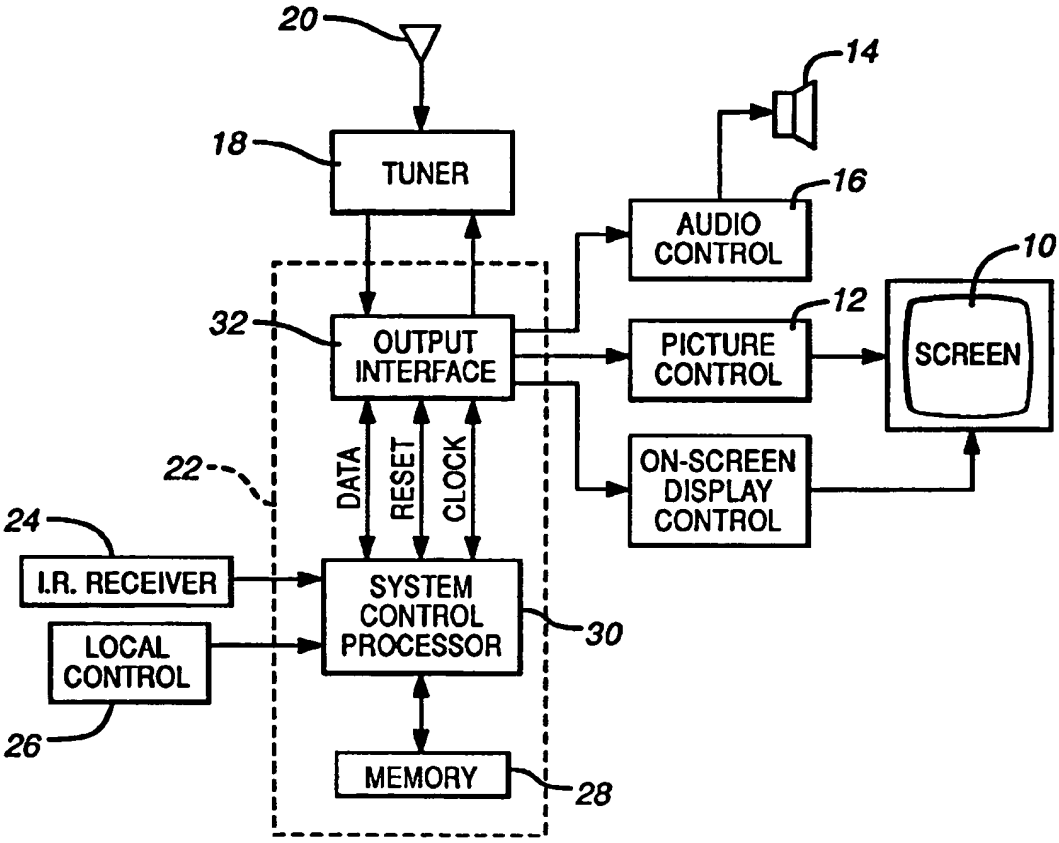

20
14
18
TUNER
16
AUDIO CONTROL
10
12
32
OUTPUT INTERFACE
PICTURE CONTROL
SCREEN
DATA
RESET
CLOCK
22
ON-SCREEN DISPLAY CONTROL
24
I.R. RECEIVER
SYSTEM CONTROL PROCESSOR
30
LOCAL CONTROL
26
MEMORY
28

FIG. 2

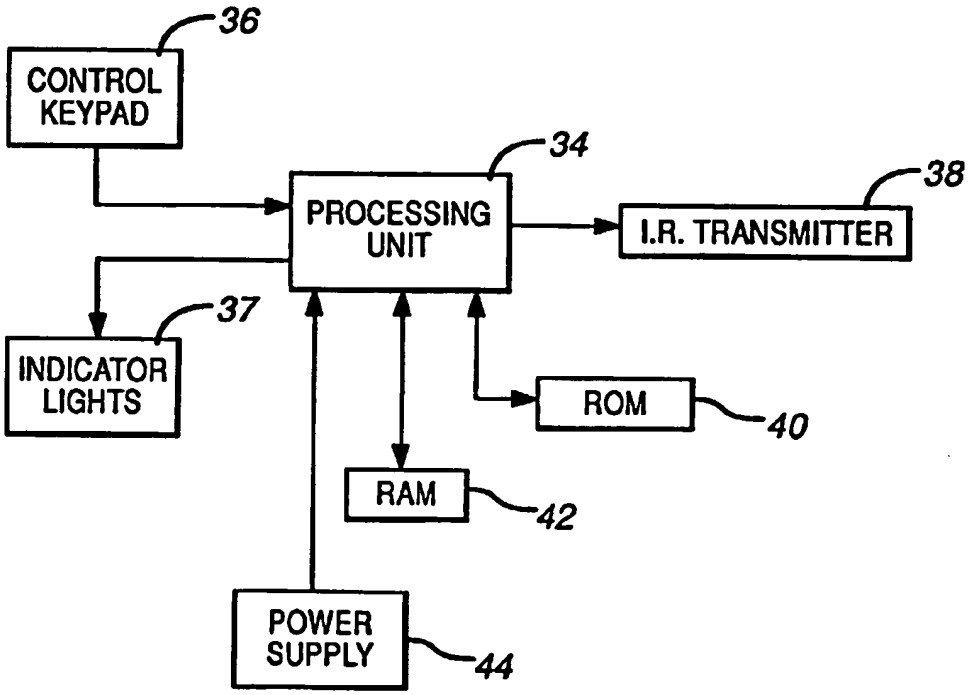

36
CONTROL KEYPAD
34
PROCESSING UNIT
38
I.R. TRANSMITTER
37
INDICATOR LIGHTS
ROM
40
RAM
42
POWER SUPPLY
44

FIG. 3

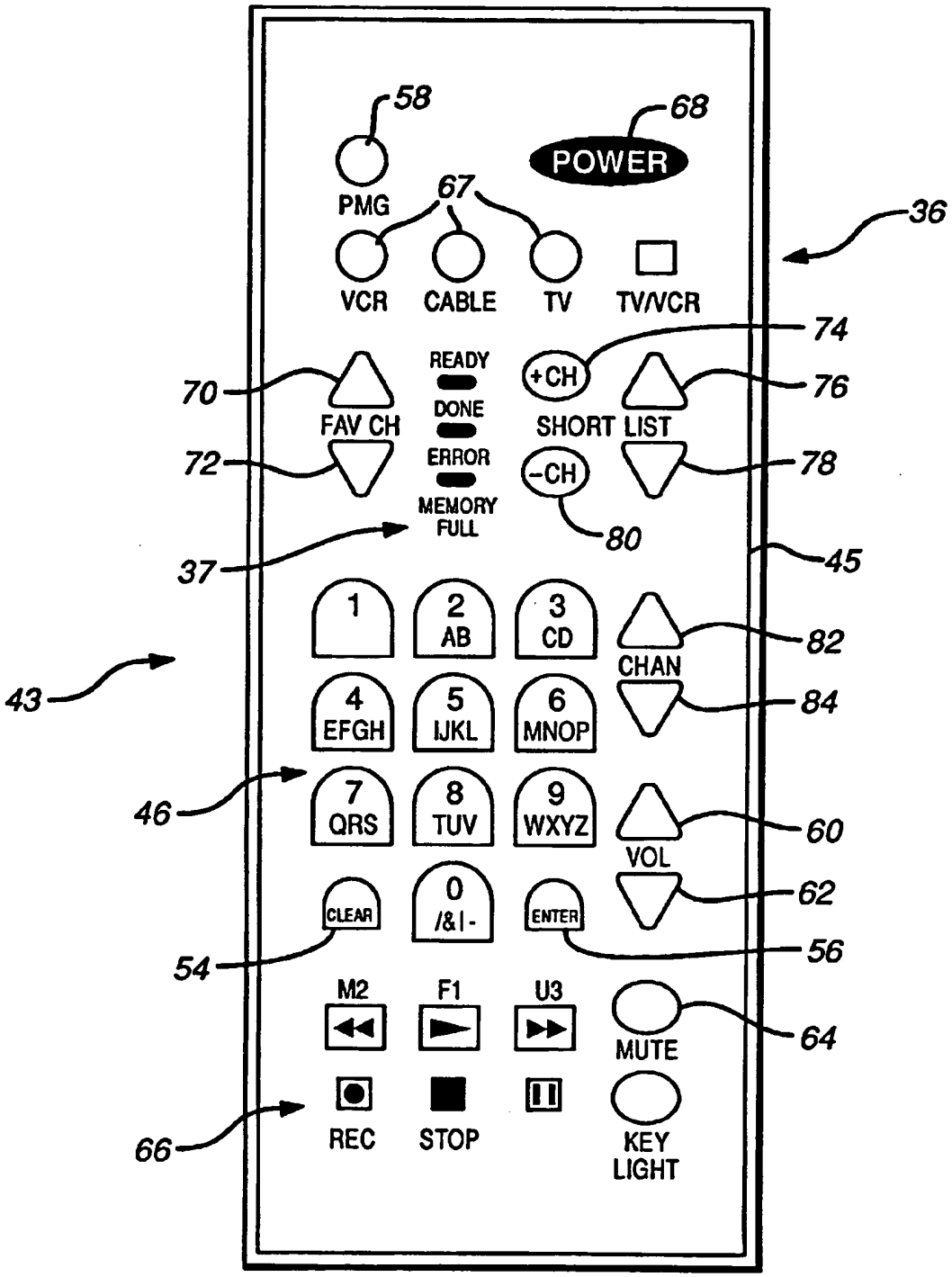

58
68
POWER
PMG
67
36
VCR
CABLE
TV
TV/VCR
74
READY
+CH
70
FAV CH
DONE
SHORT LIST
76
72
ERROR
-CH
78
MEMORY FULL
80
37
45
1
2 AB
3 CD
CHAN
82
43
4 EFGH
5 IJKL
6 MNOP
84
46
7 QRS
8 TUV
9 WXYZ
VOL
60
62
CLEAR
0 /&!-
ENTER
54
56
M2
F1
U3
MUTE
64
REC
STOP
KEY LIGHT
66

FIG. 4

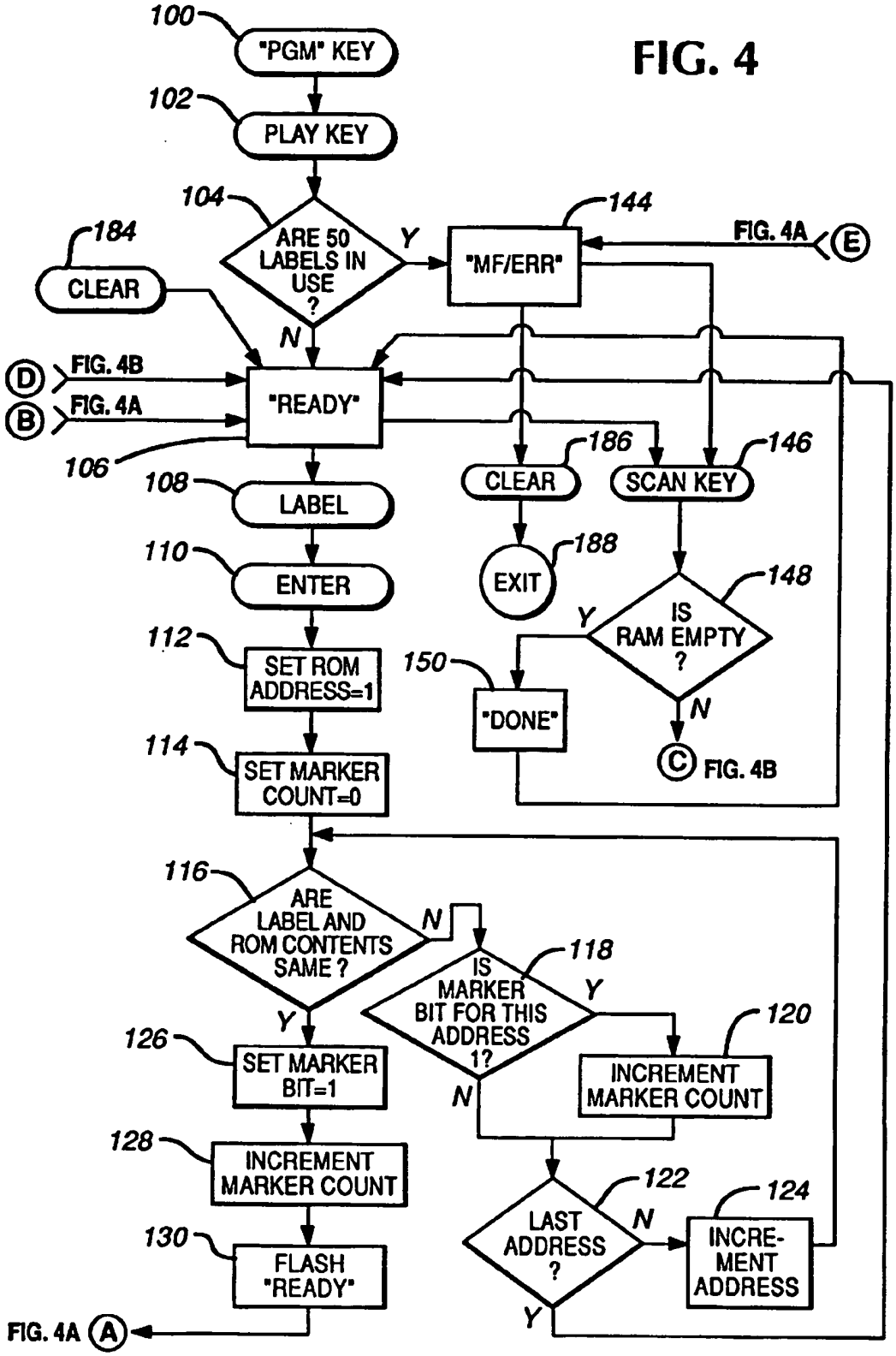

100
"PGM" KEY
102
PLAY KEY
104
ARE 50 LABELS IN USE ?
Y
N
144
"MF/ERR"
FIG. 4A
E
184
CLEAR
D
FIG. 4B
B
FIG. 4A
"READY"
106
108
LABEL
110
ENTER
112
SET ROM ADDRESS=1
114
SET MARKER COUNT=0
186
CLEAR
146
SCAN KEY
188
EXIT
148
IS RAM EMPTY ?
Y
N
150
"DONE"
C
FIG. 4B
116
ARE LABEL AND ROM CONTENTS SAME ?
N
Y
118
IS MARKER BIT FOR THIS ADDRESS 1?
Y
N
120
INCREMENT MARKER COUNT
126
SET MARKER BIT=1
128
INCREMENT MARKER COUNT
130
FLASH "READY"
FIG. 4A
A
122
LAST ADDRESS ?
N
Y
124
INCRE-MENT ADDRESS

FIG. 4A

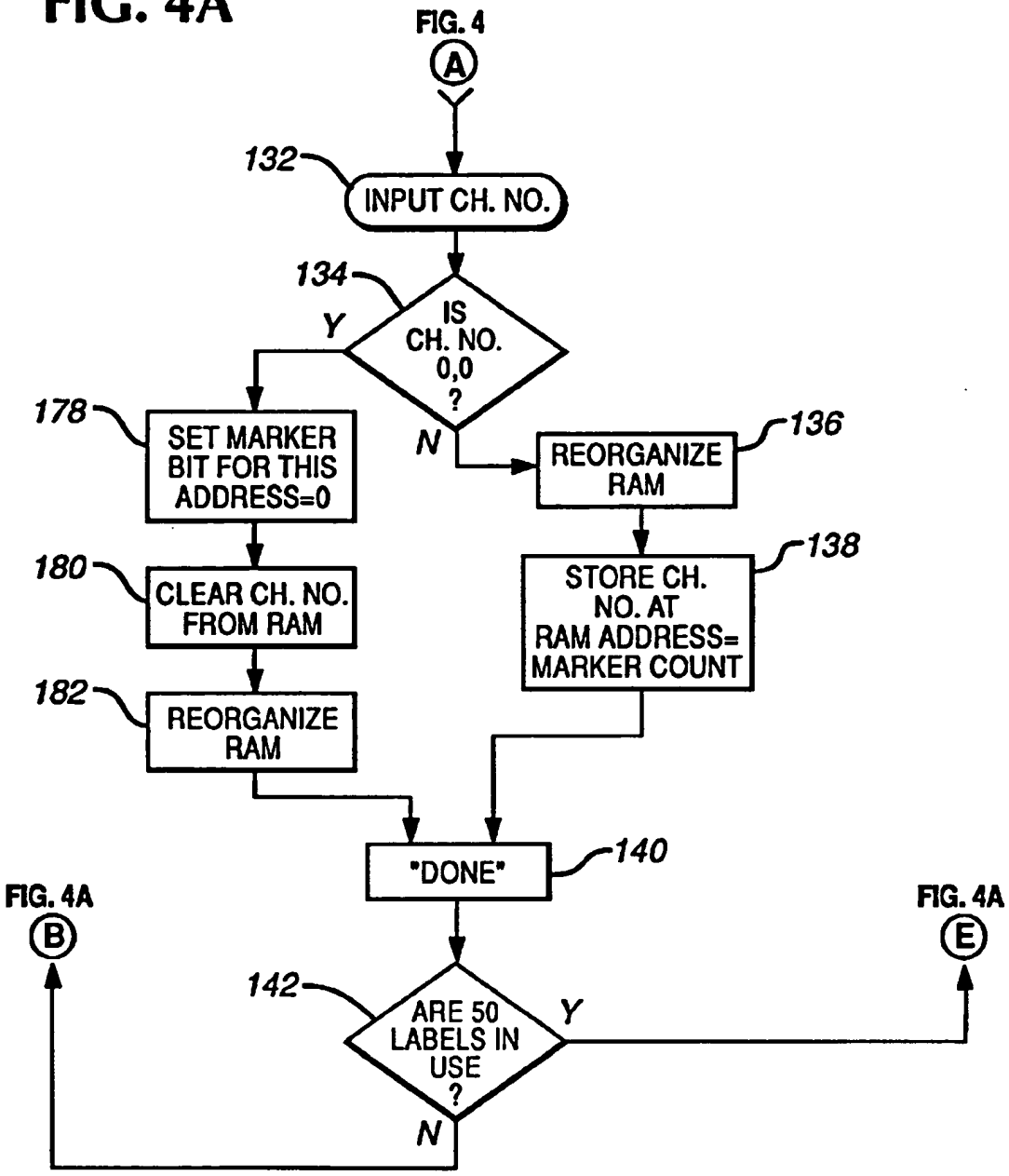


FIG. 4
A
132
INPUT CH. NO.
134
IS CH. NO. 0,0 ?
Y
N
178
SET MARKER BIT FOR THIS ADDRESS=0
180
CLEAR CH. NO. FROM RAM
182
REORGANIZE RAM
136
REORGANIZE RAM
138
STORE CH. NO. AT RAM ADDRESS= MARKER COUNT
"DONE"
140
FIG. 4A
B
142
ARE 50 LABELS IN USE ?
Y
N
FIG. 4A
E

FIG. 4B

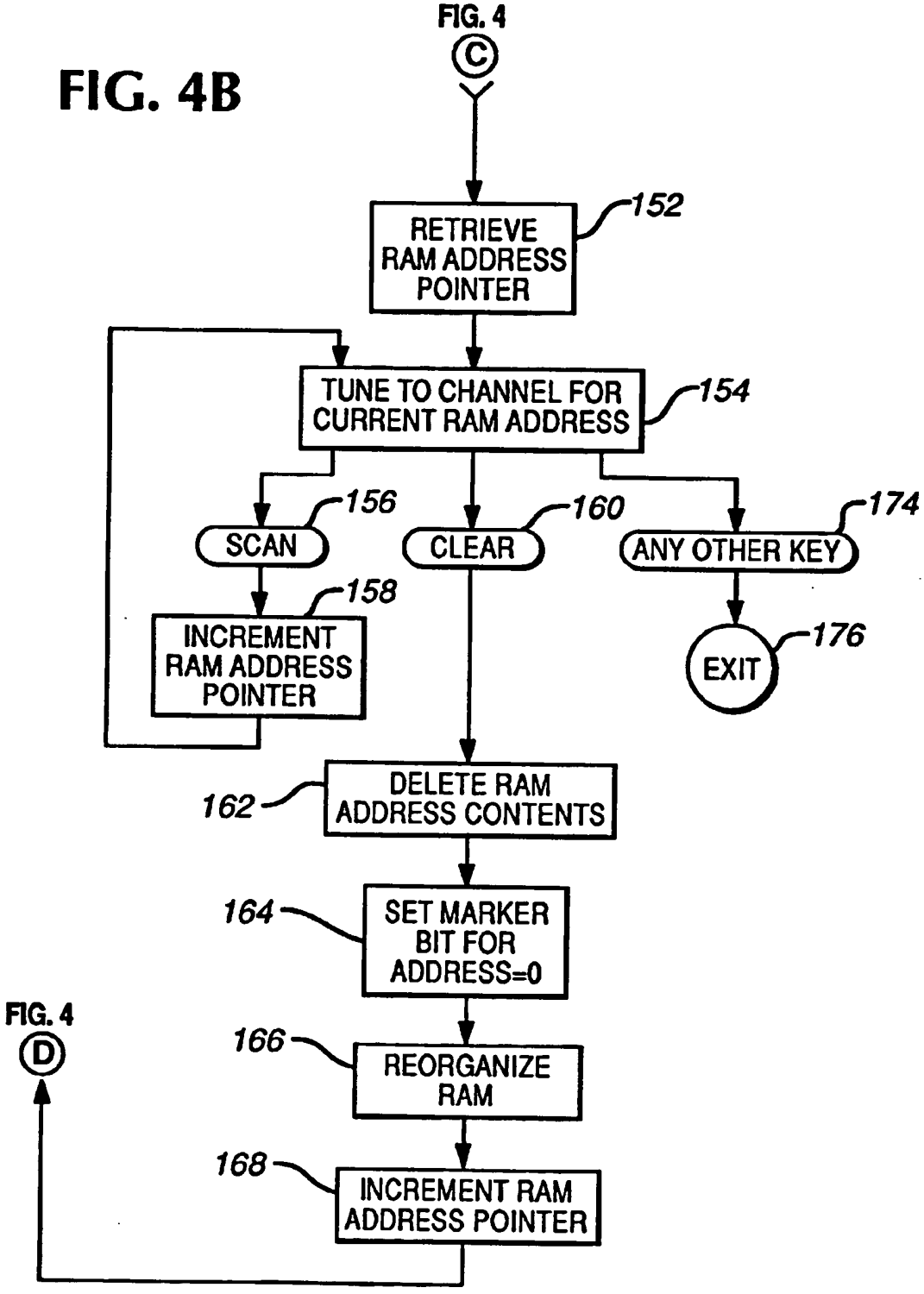


FIG. 4
C
RETRIEVE RAM ADDRESS POINTER
152
TUNE TO CHANNEL FOR CURRENT RAM ADDRESS
154
SCAN
156
CLEAR
160
ANY OTHER KEY
174
INCREMENT RAM ADDRESS POINTER
158
EXIT
176
DELETE RAM ADDRESS CONTENTS
162
SET MARKER BIT FOR ADDRESS=0
164
REORGANIZE RAM
166
INCREMENT RAM ADDRESS POINTER
168
FIG. 4
D

FIG. 5

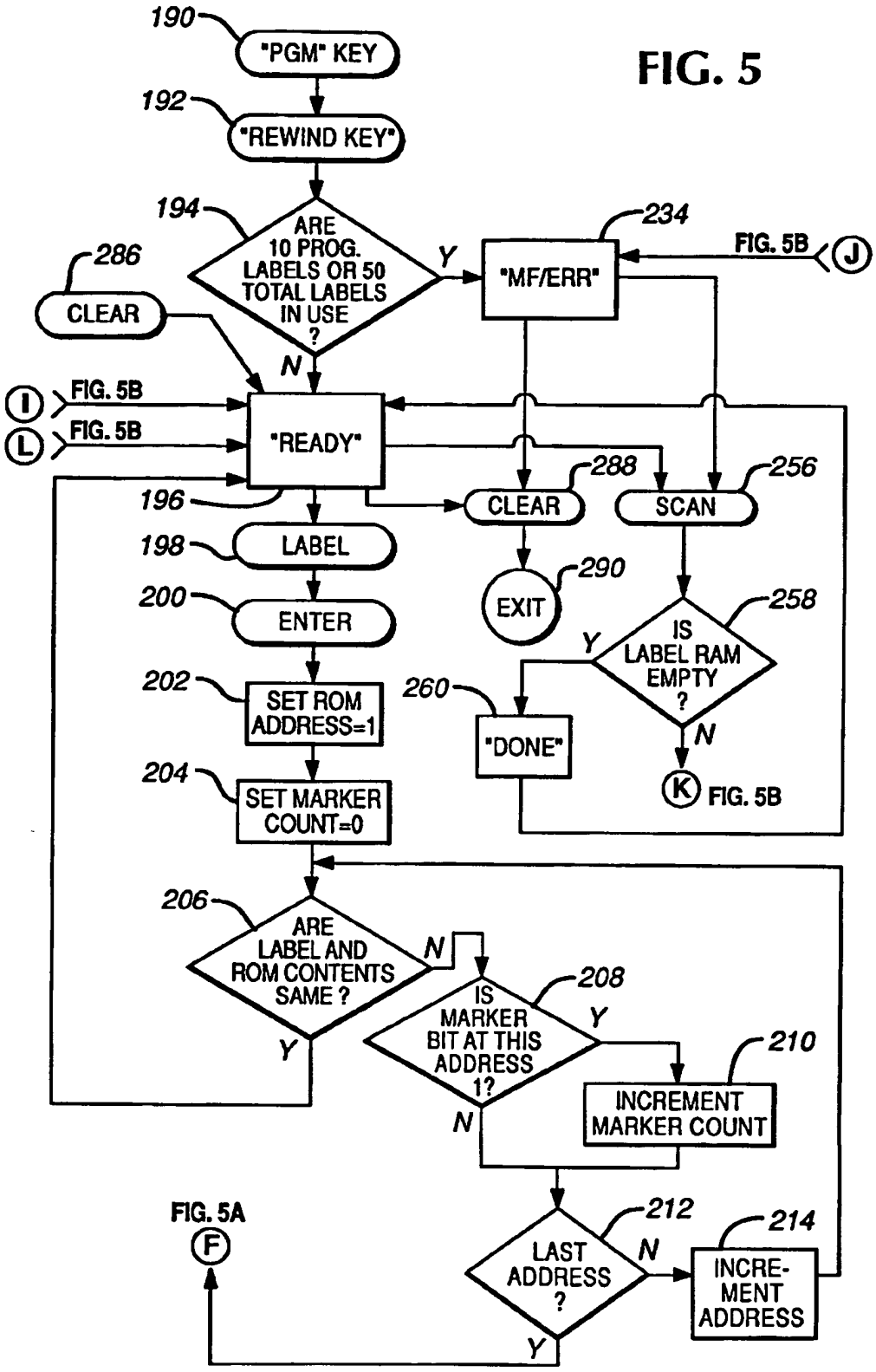

190
"PGM" KEY
192
"REWIND KEY"
194
ARE 10 PROG. LABELS OR 50 TOTAL LABELS IN USE ?
Y
N
234
"MF/ERR"
FIG. 5B
J
286
CLEAR
FIG. 5B
I
FIG. 5B
L
"READY"
196
288
CLEAR
256
SCAN
198
LABEL
200
ENTER
290
EXIT
258
IS LABEL RAM EMPTY ?
Y
N
202
SET ROM ADDRESS=1
260
"DONE"
K
FIG. 5B
204
SET MARKER COUNT=0
206
ARE LABEL AND ROM CONTENTS SAME ?
N
Y
208
IS MARKER BIT AT THIS ADDRESS 1?
Y
N
210
INCREMENT MARKER COUNT
FIG. 5A
F
212
LAST ADDRESS ?
N
Y
214
INCRE-MENT ADDRESS

FIG. 5A

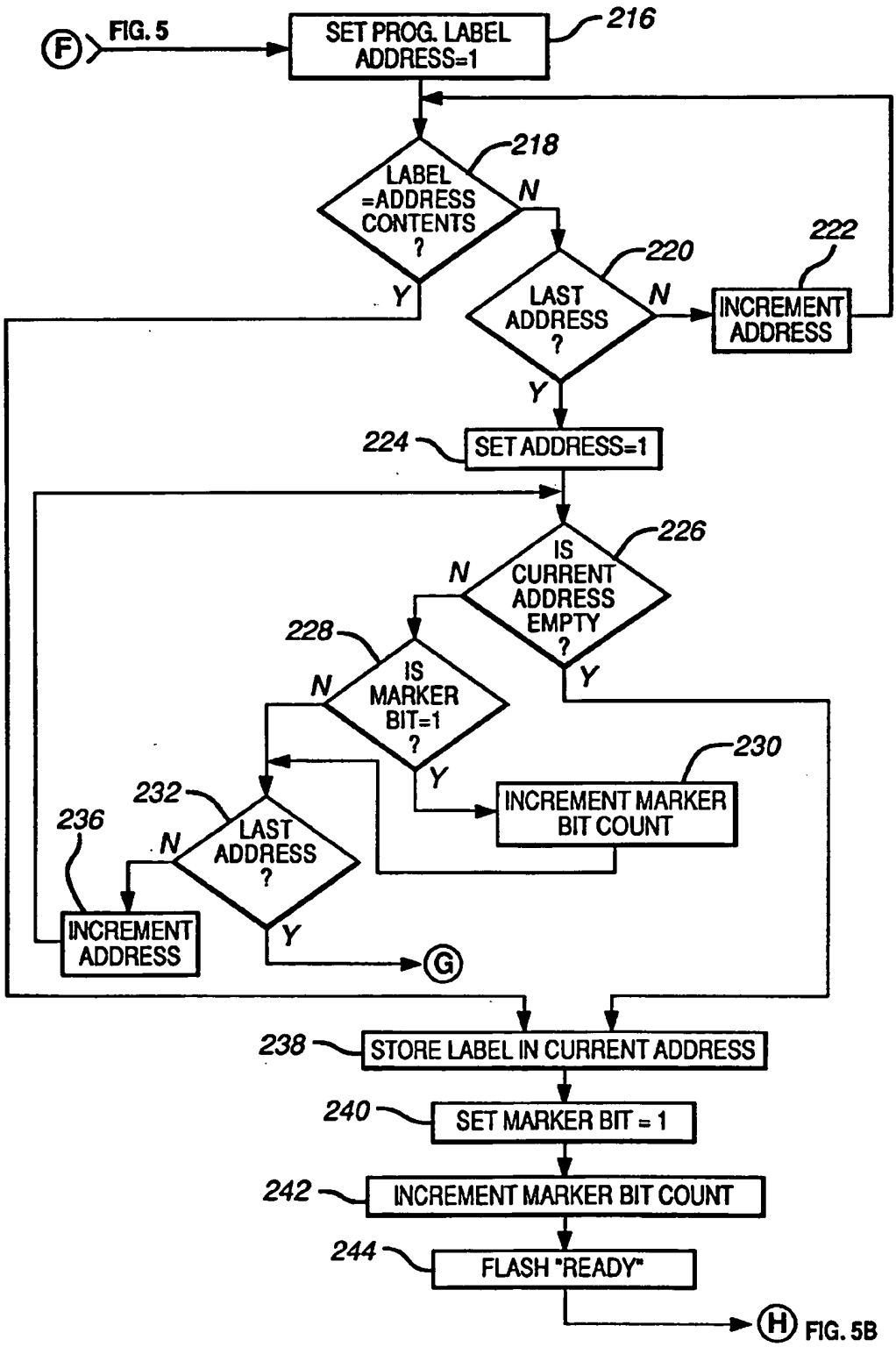


FIG. 5
SET PROG. LABEL ADDRESS=1
216
LABEL =ADDRESS CONTENTS ?
218
N
Y
LAST ADDRESS ?
220
N
Y
INCREMENT ADDRESS
222
SET ADDRESS=1
224
IS CURRENT ADDRESS EMPTY ?
226
N
Y
IS MARKER BIT=1 ?
228
N
Y
INCREMENT MARKER BIT COUNT
230
LAST ADDRESS ?
232
N
Y
INCREMENT ADDRESS
236
G
STORE LABEL IN CURRENT ADDRESS
238
SET MARKER BIT = 1
240
INCREMENT MARKER BIT COUNT
242
FLASH "READY"
244
H
FIG. 5B

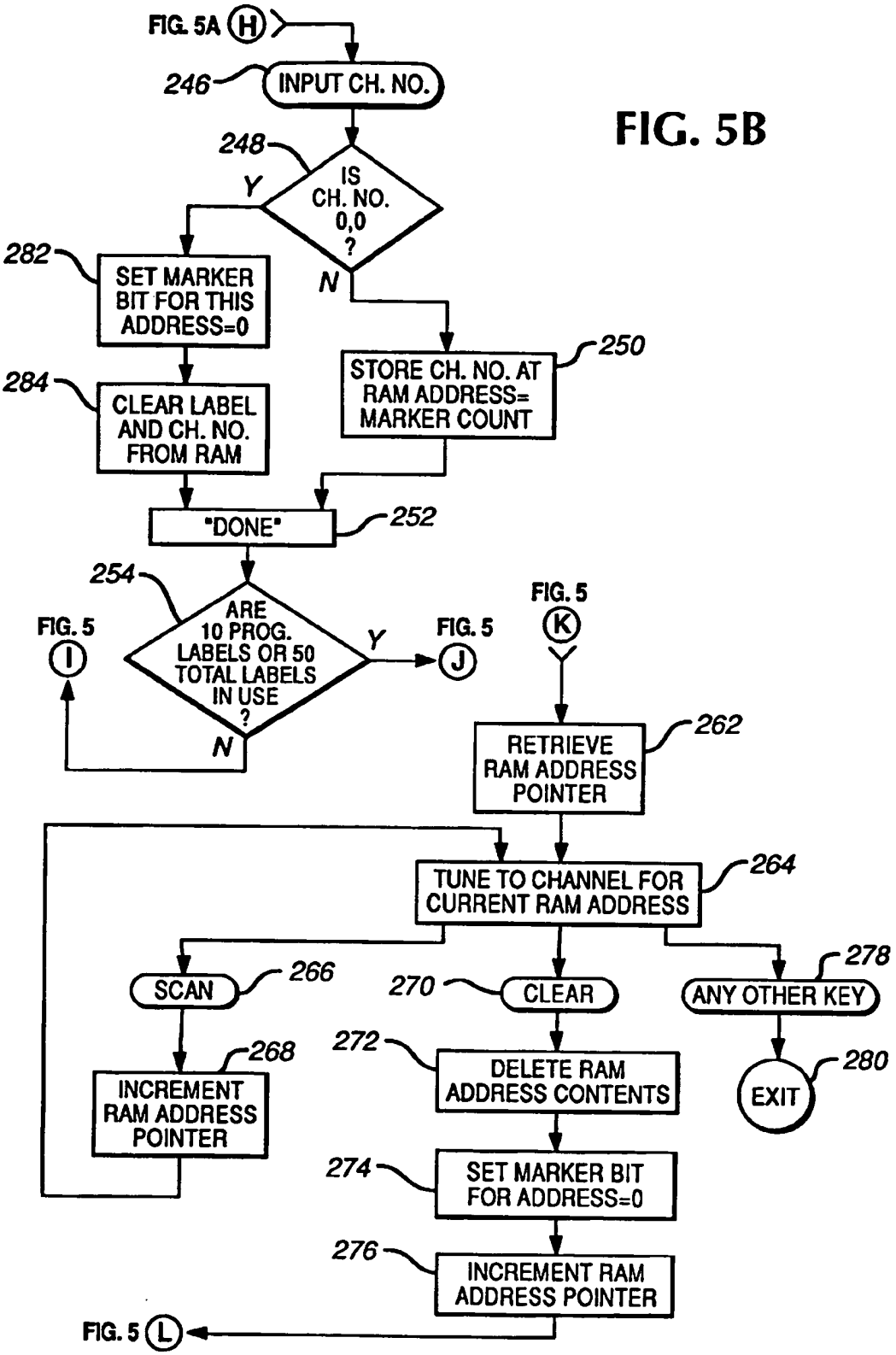


FIG. 5A H
246
INPUT CH. NO.
248
IS CH. NO. 0,0 ?
Y
N
282
SET MARKER BIT FOR THIS ADDRESS=0
284
CLEAR LABEL AND CH. NO. FROM RAM
250
STORE CH. NO. AT RAM ADDRESS= MARKER COUNT
"DONE"
252
254
ARE 10 PROG. LABELS OR 50 TOTAL LABELS IN USE ?
Y
N
FIG. 5 I
FIG. 5 J
FIG. 5 K
262
RETRIEVE RAM ADDRESS POINTER
264
TUNE TO CHANNEL FOR CURRENT RAM ADDRESS
SCAN
266
268
INCREMENT RAM ADDRESS POINTER
270
CLEAR
272
DELETE RAM ADDRESS CONTENTS
274
SET MARKER BIT FOR ADDRESS=0
276
INCREMENT RAM ADDRESS POINTER
278
ANY OTHER KEY
280
EXIT
FIG. 5 L

FIG. 5B

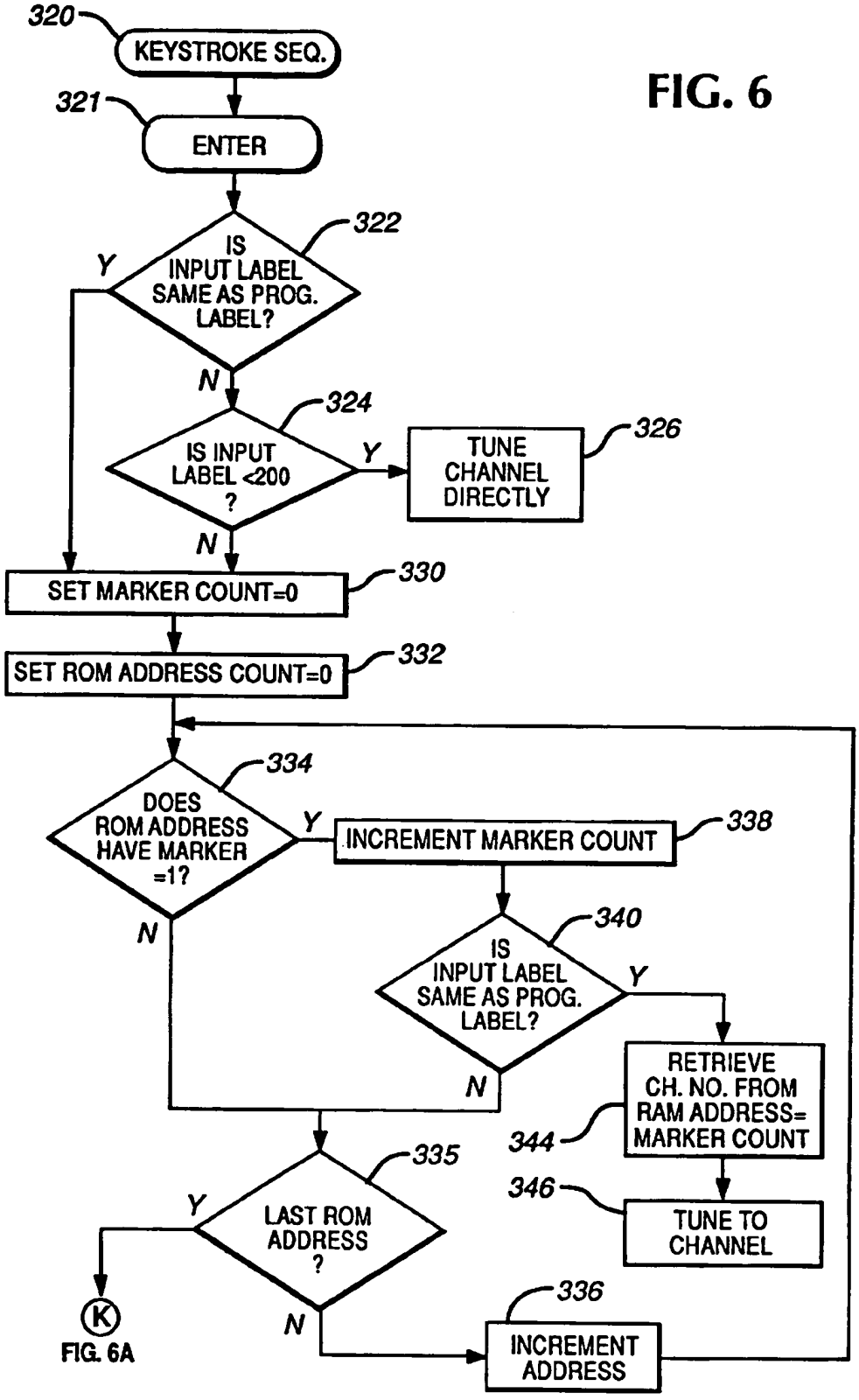

320
KEYSTROKE SEQ.
321
ENTER
322
IS INPUT LABEL SAME AS PROG. LABEL?
Y
N
324
IS INPUT LABEL <200 ?
Y
326
TUNE CHANNEL DIRECTLY
N
330
SET MARKER COUNT=0
332
SET ROM ADDRESS COUNT=0
334
DOES ROM ADDRESS HAVE MARKER =1?
Y
338
INCREMENT MARKER COUNT
N
340
IS INPUT LABEL SAME AS PROG. LABEL?
Y
N
344
RETRIEVE CH. NO. FROM RAM ADDRESS= MARKER COUNT
346
TUNE TO CHANNEL
335
LAST ROM ADDRESS ?
Y
N
336
INCREMENT ADDRESS
K
FIG. 6A

FIG. 6

FIG. 6

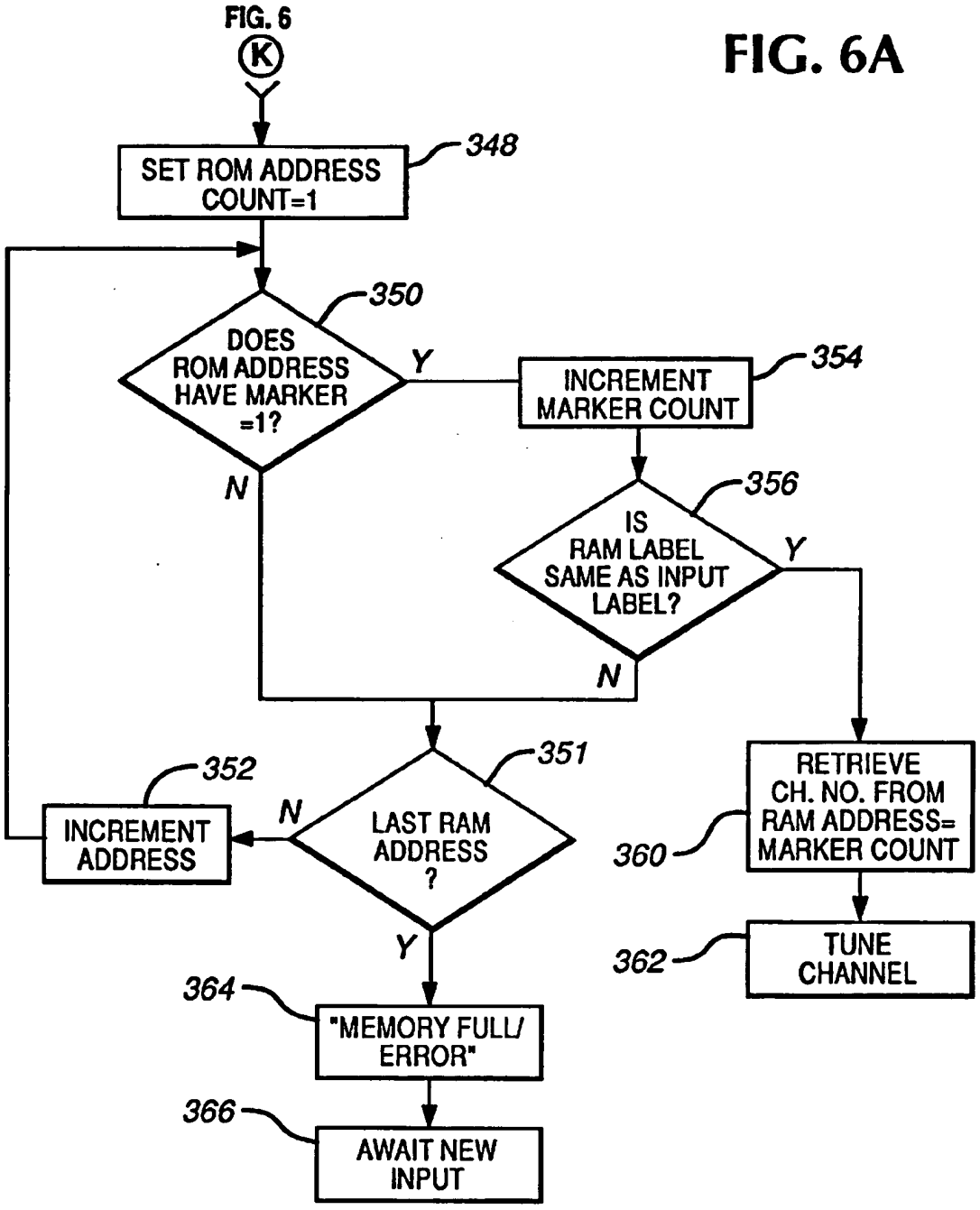

K
SET ROM ADDRESS COUNT=1
348
DOES ROM ADDRESS HAVE MARKER =1?
350
Y
N
INCREMENT MARKER COUNT
354
IS RAM LABEL SAME AS INPUT LABEL?
356
Y
N
LAST RAM ADDRESS ?
351
N
Y
INCREMENT ADDRESS
352
RETRIEVE CH. NO. FROM RAM ADDRESS= MARKER COUNT
360
TUNE CHANNEL
362
"MEMORY FULL/ ERROR"
364
AWAIT NEW INPUT
366

FIG. 6A

FIG. 7

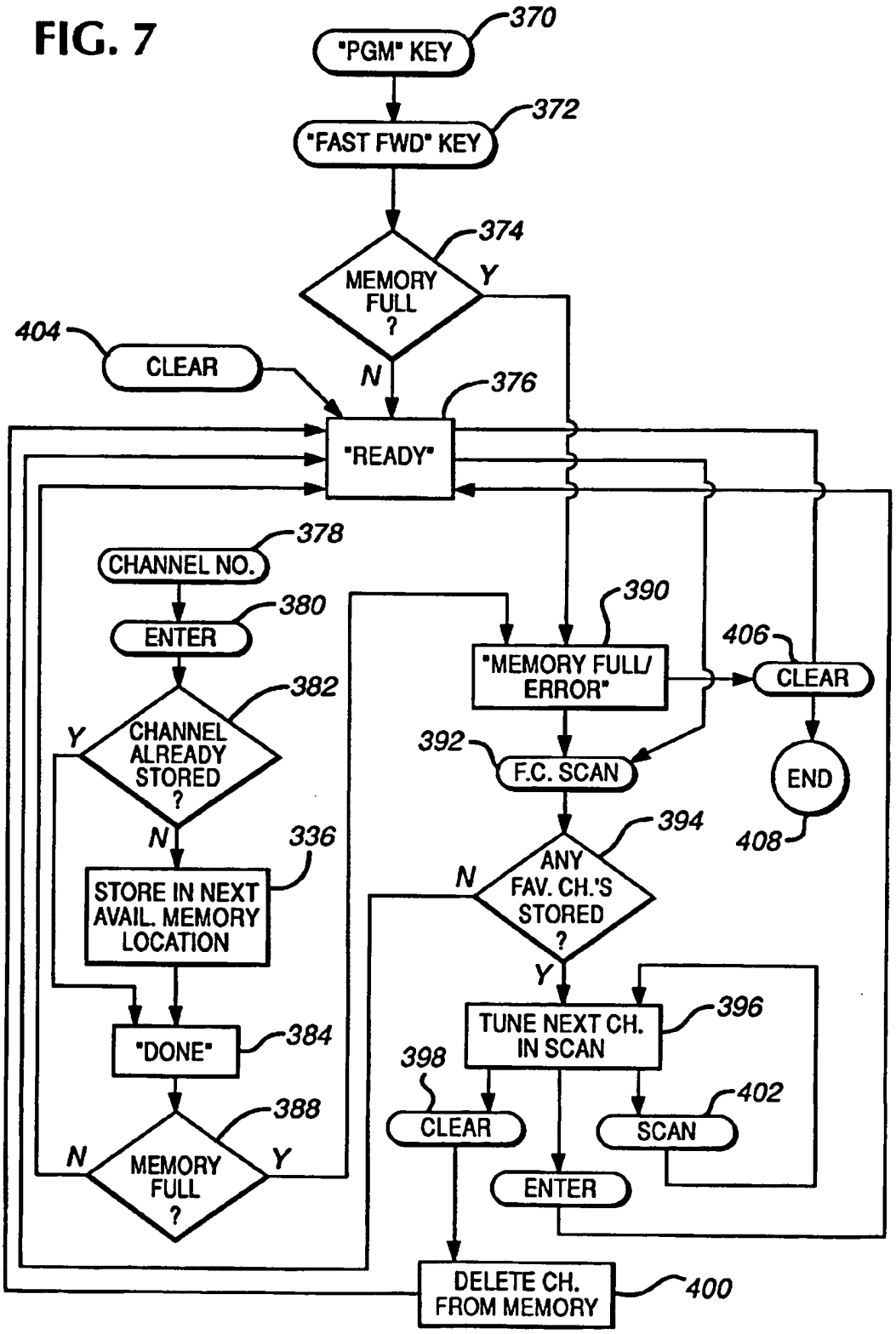

"PGM" KEY
370
"FAST FWD" KEY
372
MEMORY FULL ?
374
Y
N
404
CLEAR
376
"READY"
CHANNEL NO.
378
ENTER
380
CHANNEL ALREADY STORED ?
382
Y
N
336
STORE IN NEXT AVAIL. MEMORY LOCATION
"DONE"
384
MEMORY FULL ?
388
N
Y
390
"MEMORY FULL/ ERROR"
406
CLEAR
END
408
392
F.C. SCAN
394
ANY FAV. CH.'S STORED ?
N
Y
TUNE NEXT CH. IN SCAN
396
398
CLEAR
SCAN
402
ENTER
DELETE CH. FROM MEMORY
400

FIG. 8

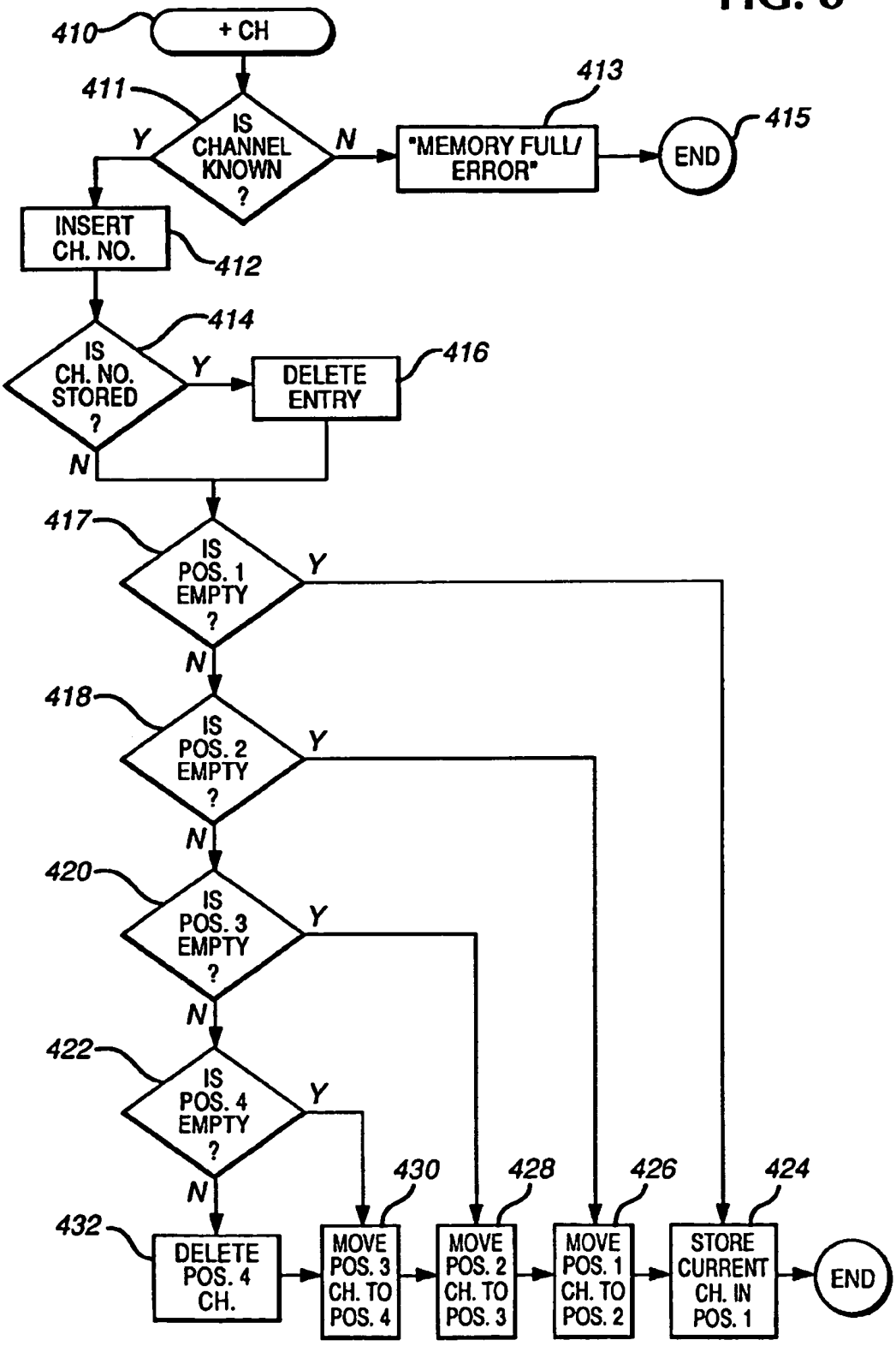
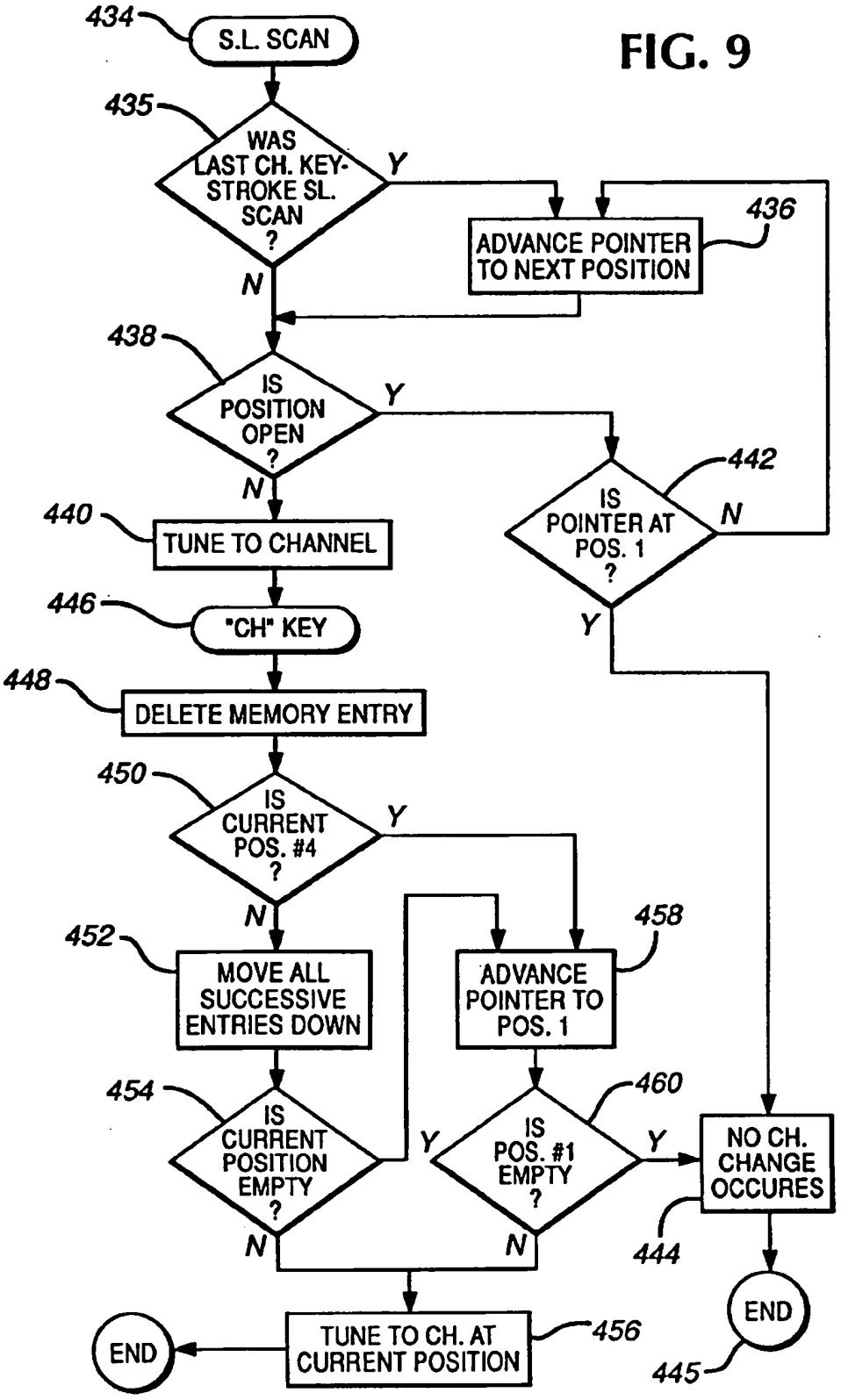

410
+ CH
411
IS CHANNEL KNOWN ?
Y
N
413
"MEMORY FULL/ ERROR"
415
END
INSERT CH. NO.
412
414
IS CH. NO. STORED ?
Y
DELETE ENTRY
416
N
417
IS POS. 1 EMPTY ?
Y
N
418
IS POS. 2 EMPTY ?
Y
N
420
IS POS. 3 EMPTY ?
Y
N
422
IS POS. 4 EMPTY ?
Y
N
430
428
426
424
432
DELETE POS. 4 CH.
MOVE POS. 3 CH. TO POS. 4
MOVE POS. 2 CH. TO POS. 3
MOVE POS. 1 CH. TO POS. 2
STORE CURRENT CH. IN POS. 1
END

FIG. 9


434
S.L. SCAN
435
WAS LAST CH. KEY-STROKE SL. SCAN ?
Y
N
436
ADVANCE POINTER TO NEXT POSITION
438
IS POSITION OPEN ?
Y
N
442
IS POINTER AT POS. 1 ?
N
Y
440
TUNE TO CHANNEL
446
"CH" KEY
448
DELETE MEMORY ENTRY
450
IS CURRENT POS. #4 ?
Y
N
452
MOVE ALL SUCCESSIVE ENTRIES DOWN
458
ADVANCE POINTER TO POS. 1
454
IS CURRENT POSITION EMPTY ?
Y
N
460
IS POS. #1 EMPTY ?
Y
N
NO CH. CHANGE OCCURES
444
END
445
END
TUNE TO CH. AT CURRENT POSITION
456

APPARATUS FOR CONTROLLING A TELEVISION RECEIVER USING A PLURALITY OF STORED LABELS

BACKGROUND OF THE INVENTION

The present invention relates generally to devices for controlling a television receiver and, more particularly, to such a devices as used for channel selection.

In recent years, a number of devices have been developed for use in controlling equipment for receiving television broadcast information such as televisions, videorecorders, cable boxes and satellite receivers. As the receiving equipment has become more complex, and the capability to broadcast an increasing variety of material has grown, the devices for controlling such equipment have become correspondingly more sophisticated.

Often (although not always), such control devices have taken the form of remote control devices useable to control a number of different pieces of equipment available from a number of different manufacturers.

As a result of the increase in available programming, there has been a need to simplify the channel selection process for the television receiver operator. With a relatively large number of channels available, the operator may have to be familiar with the channel location of various networks and individual programs, or in the alternative, may have to scan through a number of channels to find the desired broadcast. Differences between channel number assignments from one locality to the next, or from one cable service provider to the next, further complicate this problem.

Various solutions have been proposed to these problems. For example, it is known to provide a control device in which the operator may program labels for the identification of channels. In one such approach, as described in U.S. Pat. No. 4,228,541, the label is simply displayed on the television screen after the operator selects the channel using the conventional channel number. In this way, the operator can assure himself that the correct channel has been chosen.

In addition to a simple display, it is known to provide a control device in which the operator may use the label directly for channel selection in lieu of the conventional channel number assigned by the broadcaster, cable provider or governmental regulatory body. For example, in U.S. Pat. Nos. 5,045,947 and 5,068,734, the user may program labels which he creates or obtains from some other source into memory in association wit particular channel numbers. When the labels are subsequently entered into the control device, the television receiver is caused to tune the channel corresponding to the stored label.

Still further, it is known to provide the operator with a scan feature whereby the channels may be stepped through in sequence for channel selection. It is common to provide a control device having the ability to delete inactive or unwanted channels from the scan. As an enhancement to this feature, the above cited U.S. Pat. Nos. 5,045,947 and 5,068,734 disclose control devices in which channels may be placed into a scan in any desired order, or may be placed into one or more of a plurality of scanning sequences which the operator may associate with programming categories, personal preferences and the like.

Still other control devices have been developed which are directed towards problems encountered in recording television broadcasts using a videorecorder. For example, U.S. Pat. No. 5,307,173 discloses a system in which a compressed code may be found in published television program

schedules. The code is entered into the device and decoded to provide rime, date, channel and duration information concerning the program to be recorded. This data is then used by the device to control the videorecorder to record the desired program.

While such a device is useful in simplifying recording, it still requires an initial set-up operation. Because of the variation in channel numbers from locality to locality at which various networks and stations may be found, the device executes a channel conversion operation to convert a "defined" channel number used in the codes into the actual channel number at which the program may be found. This conversion is based upon an initial configuration entered by the operator that programs into memory the corresponding channel numbers.

Each of these improvements is advantageous in controlling a television receiver. However, each of these features adds further complexity to the task of initially programming the control device prior to use, or of changing the configuration when needed or desired. Additionally, each feature requires a certain amount of programmable memory for the control device. Such memory is often limited in control devices, either as a result of component capability or costs. Thus, either the capacity of, for example, a label memory is limited to a relatively small number of channels, or the number of different features which may be provided in the control device is limited, or both.

SUMMARY OF THE INVENTION

In accordance with the present invention, apparatus is provided for controlling a television receiver to select a television channel corresponding to a preassigned channel number. The apparatus includes a read-only memory for storing a plurality of labels, and a programmable memory for storing at least one channel number. An operator-actuated control generates a first signal comprising a data set representative of one of the labels and a channel number to be associated therewith. A processor receives the first signal, and responsive thereto, causes the programmable memory to store the channel number as corresponding to the one label.

The operator-actuated control further generates a second signal comprising a data set representative of the one label independent of the channel number. Upon receiving the second signal, the processor retrieves from the programmable memory the channel number and generates an output control signal corresponding to the channel number.

In one embodiment of the invention, each of the labels is stored in the read-only memory as one of an ordered series of predetermined ROM address. The programmable memory includes a plurality of RAM addresses, each of the RAM addresses being capable of storing one of the channel numbers thereat. The programmable memory also stores a marker bit value for each of the ROM addresses, and upon receipt of the first signal, the processor causes an activated value to be stored for the marker bit corresponding to the ROM address for the one label. The processor then counts the number of the activation values corresponding to the ROM addresses preceding the label and stores the channel number at the RAM address corresponding to the count.

Upon receipt of the second signal, the processor retrieves the corresponding channel number by counting the number of activation values corresponding to the ROM addresses preceding the one label and retrieving the channel number from the one of the RAM addresses corresponding to the count.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating a typical television receiver;

FIG. 2 is a block diagram illustrating a remote control device for the television control system of the present invention;

FIG. 3 is a perspective view of a remote control unit for the control system of FIG. 2; and

FIGS. 4, 4A, 4B, 5A, 5, 5B, 6, 6A, 7, 8, 9 are flowchart diagrams of a program for operating the control system of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A general block diagram of a television receiver with which a preferred embodiment of the present invention may be used is shown in FIG. 1. The specific circuitry comprising the various blocks as shown FIG. 1 are conventional, and the detailed design of the individual circuits will be known to those of ordinary skill in the art.

It will be recognized that while the preferred embodiment is described in connection with use with a television, the term "television receiver" as used herein is intended to include not only conventional television sets, but also videocassette recorders, satellite receivers, or any other apparatus capable of tuning a television signal from a multiple-channel source.

Referring now to FIG. 1, the television system includes a screen **10**, under immediate control of picture control circuitry **12** which for description purposes includes various power supply circuits, raster scan circuits, color control circuits and the like which are conventional and typically associated with a television receiver. A speaker **14** or other sound output means receives an audio output signal from audio control circuitry **16**, again which includes conventional and typical circuitry including power supply, amplifier, audio filter and similar circuits.

A tuner **18** receives a multi-channel input at **20** and tunes out all but a selected channel for viewing. It will be recognized that the multi-channel input received by tuner **18** at **20** may be a convention cable input signal, but may also be the input signal received from a satellite transmission receiver. Moreover, the present invention may be used with any television input signal, including a conventional over-the-air broadcast signal received through a conventional antenna.

Tuner **18**, audio control **16** and picture control **12** operate under the control of processing unit **22**, which may be any conventional programmable microprocessor or other means capable of receiving input control signals and producing a corresponding output control signal. Processing unit **22** in turn is controlled by conventional operator-actuated controls. These controls may be in the form of a keypad, push-button switches and/or other conventional control devices that provide the user with local control **26** directly at the television receiver. In addition, in accordance with the preferred embodiment for the invention, the television receiver also is capable of control from a hand-held remote control unit. Input from the remote unit is received, in a preferred embodiment, in the form of infrared transmissions by infrared receiver **24**. This input is in turn supplied to processing unit **22**.

Processing unit **22** includes memory **28** for storing the control program for controlling the television receiver, control processor **30** for receiving input from memory **28** and operator input from either infrared receiver **24** or local control **26** and executing the control program, and output interface **32** for directing the output from control processor **30** to the appropriate circuits. As is known, these components may be located on one or more integrated circuit chips as appropriate. As part of the control program, memory **28** includes the tuning data necessary to tune out all but one particular channel of the incoming television signal, which channel is then directed to the picture control and audio control for viewing on the television. This channel is identified, in the preferred embodiment, by a "channel number;" i.e., the numerical designation assigned to a particular incoming signal frequency by government control agencies and the number traditionally used in channel selection by television viewers.

In one preferred embodiment, the present invention may be embodied in a separate, remote control unit. Such a remote control can be adapted for use with a variety of television receivers from a variety of manufacturers, using conventional techniques well known in the art. Such a "universal" remote control can be offered for sale without being directly associated with a particular television receiver. In the alternative, it will be readily recognized that the present invention may be incorporated into a remote control which is specific to a television receiver the remote is intended to control. In a further alternative, the invention nay be incorporated into the television receiver itself, and operated either through the local control built into the television receiver, or through a conventional remote control.

One embodiment for a remote control unit in accordance with the present invention may be seen by reference to FIG. 2. The remote unit operates under control of its own processing unit **34**, which may be for example a microprocessor located on a single integrated circuit chip. Microprocessor chips suitable for use with the preset invention are commercially available from chip manufacturers such as Phillips. Connected to processor unit **34** is a control keypad **36** for operator input, including alpha-numeric and other control keys, as will be described in detail below. Also controlled by processor unit **34** is a plurality of indicator lights **37**, the lights being conventional light sources such as LEDs. A conventional I.R. transmitter **38** sends coded control instructions to the television receiver as directed by the microprocessor.

Associated with processing unit **34** is a read-only memory **40** which includes the operating program used by the remote control in controlling the television receiver, as well as the stored, preset labels to be described in detail herein. Memory **40** may be any suitable, conventional ROM (read-only memory) device. Also associated with processing unit **34** is RAM (random-access memory) **42**. This memory **42** serves to store the channels to be assigned to stored labels, as well as user labels programmed into the system. As explained in detail herein, the present invention permits a relatively small RAM to be utilized in controlling the television receiver, and the device is preferably an electrically erasable programmable read only memory (EE PROM), or a non-volatile random access memory (NV RAM), the latter preferably equipped with a battery-powered back up. Either of these alternatives are well known to those skilled in the art, and are readily commercially available. In accordance with a preferred embodiment of the present invention, both ROM and RAM are built into the microprocessor integrated circuit chip.

A power supply **44** is included for powering the remote control unit, the power supply being a battery source as is typical in the art.

A preferred embodiment for the layout of keypad **36** may be seen on the remote unit **43** shown in FIG. **3**. As can be

seen, keypad **36** may be mounted in an appropriate housing **45** which also includes a removable access panel (not shown) for the remote unit power source. The keypad includes various keys, each with its designation imprinted thereon. For example, alpha-/numeric keys **46** for numerals "0"–"9" are provided. Alphabetic characters are provided on the keys for numerals "2"–"9", with certain special characters provided on the "0" numeral key.

Keypad **36** also includes a number of special keys. The "clear" key **54**, "enter" key **56** and "PGM" (program) key **58** are used in programming the remote control unit. Other keys conventional in "universal" remote television control devices may be provided, such as volume up and volume down keys **60** and **62**, mute key **64**, conventional videorecorder control keys **66**, device selection keys **67** which enable the device to selectively control a television, videorecorder or cable control box, and a power control key **68** to turn the controlled device on and off.

Other keys **70, 72, 74, 76, 78, 80, 82** and **84** are used in connection with the programming or use of the device, and will be described in connection with such use. As will be described, certain of the videorecorder control keys **66** are used, in addition to their normal videorecorder control function, in programming the device.

Indicator lights **37** are also mounted in the housing **45** as shown.

Operation of the control system is in accordance with a program resident in processing unit **34** located within the remote unit. A preferred embodiment for the control program may be seen by reference to FIGS. **4–8**. In general, control of various television receiver functions, such as volume control, muting and the like, is conventional and will not be described herein. The channel selection portion of the program is described in detail.

The control system, in addition to conventional television tuning by direct entry of channel numbers, operates in either a "channel selection" mode, wherein the operator selects the desired viewing channel using channel labels or scan sequences which the operator has previously programmed, or in a "program" mode, wherein the label and scan sequence assignments are made, changed, reviewed and the like. Programming of labels will be described first, with specific reference made to FIG. 4.

The present invention simplifies the programming of labels in that a number of labels are prestored in the ROM and may be selectively activated by the operator for use in locating television programming. These labels may be identified by the operator by pressing the various alpha/numeric keys of the keypad **36**. In the preferred embodiment, because the alphabetic characters are imprinted on keys which are otherwise numeric keys, the system may treat both alphabetic and numeric characters in labels simply as a keystroke sequence. Moreover, for simplicity of explanation, the keystroke sequence will be described and reference herein using the decimal value represented by the numeric values imprinted on the keys which have been manipulated. That is, entry of the label "HBO" is made by pressing keys "4", "2" and "6" in sequence, and the label may be referred to herein by the numeric value "426". However, it will be recognized by those skilled in the art that as is typical, the data may actually be transmitted, stored and/or manipulated by the device as binary or hexadecimal numbers representative of the key sequence. In the "HBO" example, the data used by the system to represent the keystroke entry may be the binary value "110101010" or the hexadecimal value "1AA".

Certain predefined labels stored in ROM, or "stored labels" as referred to herein, are provided for the television services commonly provided on cable television systems and over-the-air broadcasting. In one preferred embodiment, forty-eight such stored labels are provided, one located in each of forty-eight ROM addresses. These stored labels are summarized in the following Table I:

TABLE I

Station Label	Marker Bit No.	NumericKey Sequence	Station
A&E	1	204	Arts and Entertainment
ABC	2	223	American Broadcasting Company
AMC	3	263	American Movie Classics
ATC	4	283	America's Talking
BET	5	248	Black Entertainment TV
BRV	6	278	Bravo
CBS	7	327	Columbia Broadcasting System
CMT	8	368	Country Music Television
CNBC	9	362	Consumer News and Bus.
CNN	10	366	Cable News Network
CNNH	11	3664	Headline News
CS1	12	371	C-Span 1
CS2	13	372	C-Span 2
CTV	14	388	Comedy Central
DIS	15	357	The Disney Channel
DSC	16	373	The Discovery Channel
E!-	17	400	Entertainment Network
ESN	18	476	Ent. Sports Network (ESPN)
ESN2	19	4762	ESPN 2
FOX	20	469	Fox Broadcasting
HBO	21	426	Home Box Office
HBO2	22	4262	Home Box Office 2
HBO3	23	4263	Home Box Office 3
LIF	24	554	Lifetime
MAX	25	629	Cinemax
MTV	26	688	Music Television
NBC	27	623	National Broadcasting Company
NEWS	28	6497	User's Local News Channel
NIK	29	655	Nickelodeon
PBS	30	627	Public Broadcasting Company
PLA	31	652	Playboy Channel
QVC	32	783	Value Network
SHO	33	746	Showtime
SCIFI	34	73545	Sci-Fi Channel
SPTCH	35	76834	Sports Channel
TBS	36	827	TBS Superstation
TFC	37	843	The Family Channel
TLC	38	853	The Learning Channel
TMC	39	863	The Movie Channel
TNN	40	866	The Nashville Network
TNT	41	868	Turner Network Television
TOON	42	8666	The Cartoon Network
TRAV	43	8728	Travel Channel
TWC	44	893	The Weather Channel
USA	45	872	USA Network
VH1	46	841	Video Hits 1
WGN	47	946	WGN-Chicago
WOR	48	967	WWOR-New York

Of course, it will be recognized at various other labels could be provided, and that there is no particular limitation on the number of such possible labels, subject the keystroke combinations and the size limitation of the ROM.

It will be observed that most of the labels set out in Table I are comprised of three characters, while several are comprised of four or five characters. Of course, subject to memory limitations and desired complication level in the label permitted, any number of characters may be provided for. In the preferred embodiment, each ROM address in which a stored label has been stored includes an additional data entry indicative of whether the three or more label characters are "absolute", or whether one or more "free characters" may be permitted during label use for channel selection. Any permitted free characters are ignored during label tuning. Thus, in the even free characters are permitted for the label "LIF" (keystroke sequence "554"), the user may

obtain this channel also by entering "LIFE", as the "E" in the label is simply ignored. However, free characters may not be permitted for labels such as "HBO" (keystroke sequence "426"), in which case entry of "HBOF" for channel retrieval will not result in the channel being tuned. In the "HBO" example, one reason for this restriction is the presence of labels "HBO2" and "HBO3" that require the fourth character to be properly identified.

In addition to stored labels, the preferred embodiment of the present invention permits the operator to program control labels that are not stored in ROM, but rather may be designated by the operator. Such labels, referred to herein as "programmed" labels, are stored within a reserved group of addresses in RAM. In the preferred embodiment described, ten such programmed labels may be used, with a maximum total of fifty activated labels, both stored and programmed, being permitted. Use of the full ten programmed labels limits the operator to activation of forty stored labels, while use of only nine programmed labels permits activation of forty-one stored labels, and so forth.

The program for activation of stored labels for subsequent use in channel selection is shown in flowchart form in FIG. **4**. The operator begins the program by pressing the "PGM" key (key **58** in FIG. **3**), shown at block **100**. The operator next presses a "stored labels" function key, as shown at block **102**. In the preferred embodiment, to reduce the number of keys located on the remote control unit, this function key may be one of the videorecorder control keys, such as the "PLAY" key. When actuated after the "PGM" key, the system recognizes the alternate function for this dual-function key.

The program determines, at block **104** whether fifty labels have already been activated, and if not, the "Ready" light is illuminated as indicated at block **106**.

Upon observing the "Ready" light, the operator enters, block **108**, the desired label to be activated. As previously noted, the operator manipulates the alpha/numeric keys **46** of keypad **36** using both the alphabetic and numerical designations imprinted on the keys. The program, however, as a minimum needs only to use the numerical value associated with the input keystrokes. After the label has been entered, the operator presses the "Enter" key, block **110**.

As will be explained in greater detail herein, the present invention conserves RAM in the label programming operation through the use of marker bits as an indication as to which of the available stored labels has been activated. In this way, one-to-one correspondence of channel numbers for each stored label is not required. Instead, the software is able to relate each activated label to corresponding channel number stored at a memory position.

When a stored label is activated, a marker bit value of "1" is associated with that ROM memory position, indicating that the label is activated. To store the corresponding channel number, the program counts sequentially the number of ROM addresses with marker bits having values of "1" up to the address at which the selected stored label is located. This marker count is then used as the RAM address for storing the corresponding channel number.

Thus, as an example, consider that the label for "HBO" (value "426") is to be activated. While this label is found in ROM address "21", it may be for example that it is only the eighth of the labels having a marker bit value of "1". Hence, RAM address "8" will be used to store the channel number in this case.

Considered differently, assume that activation of up to forty of the forty-eight stored labels is desired. Each of the forty-eight ROM addresses requires a marker bit of "1" or "0" in RAM, or six bytes of memory. Further, assume that one byte of memory is required to store the channel number to be associated with the label. (This latter assumption is based on the capability of one byte to record values from "0" to "255". Most television receivers currently sold have the capability of tuning channels of numbered "2" through "125".) Thus, only 46 bytes of programmable memory is required to fully store the data necessary to associate labels with channel numbers.

Returning to the program shown in FIG. **4**, and following entry of the desired label, an address counter for the ROM is set to address "1", block **112**. A marker bit counter is set to zero, shown at block **114**.

The program checks at block **116** to determine whether the entered label is the same as the label stored un ROM address "1". If they are not the same, the program next checks at block **118** to determine whether the marker bit value for this ROM address has been set to "1". If it has, the marker counter is incremented, block **120**. If at block **118** it is determined that the marker value is "0", the program bypasses block **120**.

In either case, the program next determines at block **122** whether the current ROM address is the last ROM address (for the preferred embodiment, ROM address "48"). If not, the program increments the address counter, block **124**, and returns to block **116** to check the input label against the contents of the next ROM address.

In the event a match between the input label and the stored label at the current address is found, the marker bit for that address is set to a value of "1", block **126**. The marker count is then incremented at block **128** and the "Ready" light is flashed at block **130**, indicating that the system is ready to receive the channel number which is to correspond to the selected label. The channel number is input by the operator using the keyboard, block **132**, and the channel number is checked to determine whether it is input as "0,0", block **134**. Such an input is used in deactivating stored labels as will be described. Assuming the channel number is some value other than "0,0", the RAM is reorganized, block **136**, as described below, to create an empty memory address in RAM at the address that corresponds to the current marker count. The channel number is stored at that address as shown at block **138**. In the event a channel number value has been previously stored for this label, which occurs if the label is already in use, the newly-entered channel number overwrites the already-stored value.

Thus, each selected stored label is related by the system software to a memory position. In the preferred embodiment, the label that is identified with the first active marker bit is associated with the channel number stored in the first RAM address, the label identified with the second active marker bit is associated with the channel number stored in the second RAM address, and so forth. However, it will be recognized that RAM addresses may alternatively be associated with marker bits in descending order, in an every-other alternating order, or in any other manner as long as there is a predictable relationship between marker bit order and RAM address.

As an example, consider that the available stored labels are those set out in the order shown in Table I. Eleven stored labels have been activated, and the corresponding channel numbers are stored in RAM addresses 1 through 11. The system status may be summarized as shown in Table II:

TABLE II

RAM Address	Label	Channel No.	ROM Address
1	A&E	49	1
2	AMC	45	3
3	BET	59	5
4	CNN	30	10
5	DIS	6	15
6	ESN	37	18
7	FOX	29	20
8	HBO	3	21
9	MAX	5	25
10	SHO	4	33
11	TNT	18	41

Now the operator wants to add CBS which is received on channel number "9". The system recognizes from the marker count that the label for CBS should be located in the fourth position in RAM, i.e., the label is the fourth item in ROM having a marker bit at logic "1".

The system then reorganizes the RAM to create an empty address at position four. This can be illustrated by the following Table III that reflects the channel numbers and station labels associated with the memory position.

TABLE III

RAM Address	Start	Reorganized Memory	"CBS" Added
1	49 (A&E)	49 (A&E)	49 (A&E)
2	45 (AMC)	45 (AMC)	45 (AMC)
3	59 (BET)	59 (BET)	59 (BET)
4	30 (CNN)	Available	9 (CBS)
5	6 (DIS)	30 (CNN)	30 (CNN)
6	37 (ESN)	6 (DIS)	6 (DIS)
7	29 (FOX)	37 (ESN)	37 (ESN)
8	3 (HBO)	29 (FOX)	29 (FOX)
9	5 (MAX)	3 (HBO)	3 (HBO)
10	4 (SHO)	5 (MAX)	5 (MAX)
11	18 (TNT)	4 (SHO)	4 (SHO)
12	Available	18 (TNT)	18 (TNT)

After the channel number has been stored in the appropriate location in RAM, the program causes at block **140** the "Done" light to illuminate. This light will remain illuminated for a period of three seconds, whereafter the system checks at block **142** to determine whether fifty labels have been activated. If not, the program returns to block **106**, where the "Ready" light is illuminated and the system awaits the activation of another label or some other action by the operator.

In the event the system determines that all fifty available activated labels have been used, either at block **104** or at block **142**, the system causes the "Memory Full/Error" ("MF/ERR") light to illuminate as shown at block **144**. At this point, the operator's action may consist of simply exiting the program. In the alternative, the operator may choose to delete one or more of the activated labels from RAM to make space for the addition of other labels.

The operator may also choose to delete label entries when less than the maximum fifty labels have been activated. This may be accomplished when the program is at the "Ready" light shown in block **106**.

In either case, the operator presses either of the scan keys **82** and **84** (see keypad layout in FIG. **3**), indicated at block **146**. Upon actuation of one of these keys, the program at block **148** determines whether the RAM is empty, in which case no labels are activated. In this case, the "Done" light is illuminated for three seconds, block **150**, and the program returns to the illumination of the "Ready" light at block **106**.

In the event that there are one or moire entries in RAM, the program advances to block **152**, where a RAM address scan pointer is retrieved. The controller then sends an instruction to the television receiver to tune to the channel number stored in the current RAM address as indicated by the pointer value, block **154**. It will be recognized, however, that the controller operates independently of the television receiver, and it is therefore not necessary to the operation of the controller that the receiver actually receive, or respond to, the transmitted instruction. In fact, the television receiver may be off during programming of the controller.

Upon viewing this channel, the operator may decide to retain this channel in the group of activated labels. The operator may then depress the scan key, block **156**, which increments the RAM address, block **158**, and the program returns to block **154** where the next channel is displayed on the television screen. (It will be recognized that this assumes that the scan "up" key is pressed. In the event the scan "down" key is depressed, the RAM address will be decremented, but otherwise the program operation is the same.) Of course, as is common in the art, this scan is arranged in the form of a ring, so that a scan "up" command from the last address moves the pointer to the first address, and a scan "down" command from the first address moves the pointer to the last address.

If the operator decides to deactivate the channel displayed on the screen, the operator presses the "Clear" key as shown at block **160**. The RAM contents at the current address are deleted (or in other words, are set to a value of zero), block **162**. Next, at block **164**, the marker for the ROM address (or the programmed label address in the case of programmed labels) is set to zero. While this procedure is not detailed in the flowchart of FIG. **4**, it will be recognized that this may be done by advancing through the marker bits until the activated (i.e., bit value "1") bit count equals the current RAM address. This bit is then set to a value of zero.

Next, at block **166**, the RAM is reorganized to remove the deleted or zero-value address entry. This can be illustrated by the following Table IV that reflects the channel numbers and station labels associated with the memory position, in which the operator decides to delete the label FOX:

TABLE IV

RAM Address	Start	"FOX" Deleted	Reorganized Memory
1	49 (A&E)	49 (A&E)	49 (A&E)
2	45 (AMC)	45 (AMC)	45 (AMC)
3	59 (BET)	59 (BET)	59 (BET)
4	9 (CBS)	9 (CBS)	9 (CBS)
5	30 (CNN)	30 (CNN)	30 (CNN)
6	6 (DIS)	6 (DIS)	6 (DIS)
7	37 (ESN)	37 (ESN)	37 (ESN)
8	29 (FOX)	Available	3 (HBO)
9	3 (HBO)	3 (HBO)	5 (MAX)
10	5 (MAX)	5 (MAX)	4 (SHO)
11	4 (SHO)	4 (SHO)	18 (TNT)
12	18 (TNT)	18 (TNT)	Available

Once the RAM has been reorganized, the RAM address pointer is incremented, block **168**, and the program returns to the "Ready" light at block **106**.

During channel display during the label clearing operation, in the event the operator presses any key other than "Scan" or "Clear", as shown at block **174**, the program is exited, block **176**, and normal television operation is resumed.

As an alternative, the program logic could be arranged to provide that any keystroke other than "Scan" or "Clear"

returns the program to block **106** and illuminates the "Ready" light. The choice of arrangements may be determined by the programmer as to which is more compatible with the human interface.

An alternate method for label clearing can be performed as shown in FIG. **4**. From the "Ready" light at block **106**, the operator may enter the specific label he wishes to deactivate. The program advances through blocks **108**, **110** and so forth to block **130** where the "Ready" light is again illuminated. Instead of entering a channel number, as done during label programming, the operator enters the value "0,0". The program sets the marker value for the corresponding ROM address (or programmed label address) to zero, block **178**, and "clears" the channel number at block **180** by entering a zero value. The RAM is then reorganized in the manner shown by Table IV at block **182**, and the "Done" light is illuminated at block **140** for three seconds. The program then continues as has been described previously.

The label programming routine may be exited without completing the programming routine in progress. Except at block **154**, pressing the "Clear" key as shown at block **184** interrupts the program and returns to the "Ready" light at block **106**. When the "Ready" lamp is illuminated, pressing the "Clear" key as shown at block **186** will cause the program to exit, shown at block **188**. Thus, if the "Ready" lamp is not illuminated during operation of the program shown in FIG. **4**, pressing the "Clear" key twice will exit the program.

In addition, at any point in the program where operator input is needed, a lack of input for fifteen seconds will cause the program to "time out" and return the system to normal operation.

As has been noted, in addition to stored labels, the operator, may activate programmed labels which may be characters entered by the operator other than those stored in ROM as stored labels. A portion of RAM is reserved for up to ten of these programmed labels, which are otherwise generally handled by the program in a manner similar to the stored labels. To create a programmed label, the operator enters the label program of FIG. **5**, beginning the program by pressing the "PGM" key (key **58** in FIG. **3**), shown at block **190**. The operator next presses a "programmed labels" key, which in this embodiment is an alternate function for the videorecorder "REWIND" key, as shown at block **192**. The program determines, at block **194** whether ten programmed labels or fifty total labels have already been activated, and if not, the "Ready" light is illuminated as indicated at block **196**.

Upon observing the "Ready" light, the operator enters, block **198**, the desired label to be stored, and the "Enter" key, block **200**. The label may be any keystroke sequence corresponding to one or more keystrokes, up to the limit permitted by the memory configuration.

As in the case of the stored labels, marker bits are used as an indication that a programmed label has been created. When a stored label has been created, a marker bit value of "1" is associated with that ROM memory position, indicating that the label is activated. To store the corresponding channel number, the program counts sequentially the number of RAM addresses for programmed labels with marker bits having values of "1" up to the address at which the selected stored label is located. This marker count is then added to the marker count for the stored label ROM addresses, and used as the RAM address for storing the corresponding channel number.

In the preferred embodiment, a marker bit is associated with each of the ten possible programmed labels. This is done as a convenience in that the data handling routines are similar for both stored and programmed labels. However, as an alternate embodiment, the "marker bit" may be a determination that the address contents are not all zeros. A marker value is the existence of this condition.

Following entry of the desired label, a check is made to determine whether the desired program label is the same as one of the stored labels, whether activated or not. The program will not permit programmed labels to be the same as stored labels. Because only ten programmed labels are available, this prevents the operator from using one or more of this limited number of addresses to store a label already available elsewhere in the system. Thus, an address counter for the ROM is set to address "1", block **202**. A marker bit counter is set to zero, shown at block **204**.

The program checks at block **206** to determine whether the entered label is the same as the label stored in ROM address "1". If they are not the same, the program next checks at block **208** to determine whether the marker bit value for this ROM address has been set to "1". If it has, the marker counter is incremented, block **210**. If not, block **210** is bypassed.

In either case, the program next determines at block **212** whether the current ROM address is the last ROM address (for the preferred embodiment, ROM address "48"). If not, the program increments the address counter, block **214**, and returns to block **206** to check the input label against the contents of the next ROM address.

In the event a match is found at block **206** between the input label and a stored label at the current address is found, the program returns to the "Ready" light at block **196**, indicating that the input label cannot be used as a programmed label.

In the event no match is found between the input label and any stored label, the program next checks to determine whether the entered label is the same as any previously used programmed label, in which case the program will overwrite the previously programmed corresponding channel number with the new. Thus, at block **216**, the programmed label address of the RAM is set to 1, and a determination is made at block **218** whether the label is the same as that in the first memory address. If not, the program determines at block **220** whether this is the last (i.e., tenth in the preferred embodiment) address, and if not, the address is incremented at block **222**. The program returns to block **218** and block **220** until all address contents have been checked. If the entered label has not been found, the address is reset to 1 at block **224** and a determination is made at block **226** whether the contents of this address is zero (i.e. empty). If not, the program confirms whether the marker bit associated with this address has a value of "1", block **228**, and if so, increments the marker count at block **230** (which continues the count begun during the review of stored labels in ROM). A determination is made whether this is the last address for programmed labels at block **232**, and if so, this indicates that all ten memory addresses have labels stored therein. The program moves to block **234**, where the "Memory Full/Error" ("MF/ERR") light is illuminated. If it is not the last address, the address is incremented, block **236**, and the next address is checked.

In the event an empty address is found at block **226**, or in the event the input label is the same as a label already stored as determined at block **218**, the label is stored in the current address as shown at block **238**. The marker bit associated with this address is set to "1", block **240**, and the marker count is incremented at block **242**. The program then flashes the "Ready" light, block **244**, to indicate to the operator that the channel number to correspond to the label may be entered.

The channel number is input by the operator using the keypad, block **246**, and the channel number is checked to determine whether it is input as "0,0", block **248**. Such an input is used to deactivate programmed labels, as is the case with stored labels described above. Assuming the channel number is some value other than "0,0", the channel number is stored at the address that corresponds to the current marker count, as shown at block **250**.

After the channel number has been stored in the appropriate location in RAM, the program causes the "Done" light to illuminate, block **252**. This light will remain illuminated for a period of three seconds, whereafter the system checks at block **254** to determine whether ten programmed labels have been activated. If not, the program returns to block **196**, where the "Ready" light is illuminated and the system awaits the activation of another label or some other action by the operator.

In the event the system determines that all ten available labels have been used, either at block **194** or at block **254**, the system causes the "Memory Full/Error" light to illuminate as shown at block **234**. At tis point, in a manner similar to that used for stored labels, the operator may choose to exit the program or delete one or more of the programmed labels from memory.

The operator may also delete label entries when the program is at the "Ready" light shown in block **196**.

In either case, the operator presses either of the scan keys **82** and **84** (see FIG. **3**), indicated at block **256**. Upon actuation of one of these keys, the program at block **258** determines whether the label RAM is empty, in which case no labels are activated. In this case, the "Done" light is illuminated for tree seconds, block **260**, and the program returns to the illumination of the "Ready" light at block **196**.

In the event that there are one or more entries in RAM, the program advances to block **262**, where the current RAM address pointer is retrieved and an instruction is set to the television to tune to the channel number stored in this RAM address, block **264**.

Upon viewing this channel, the operator may decide to retain this channel in the group of activated labels. The operator may then depress the scan key, block **266**, which increments the RAM address, block **268**, and the program returns to block **264** where an instruction to the television receiver to display the next channel is transmitted.

If the operator decides to deactivate the label associated with the current channel, the operator presses the "Clear" key as shown at block **270**. The RAM contents at the current address are deleted (or in other words, are set to a value of zero), block **272**. Next, at block **274**, the marker for the label RAM address is set to zero.

At block **276**, the RAM address pointer is incremented, and the program returns to the "Ready" light at block **196**.

During channel display during the label clearing operation, block **264**, in the event the operator presses any key other than "Scan" or "Clear", as shown at block **278**, the program is exited, block **280**, and normal operation is resumed. (As with stored labels, in an alternate embodiment, the program may be designed whereby pressing of any key other than "Scan" or "Enter" returns the program to the "Ready" light at block **196**. In this way, the operator may simply decide to keep all current labels.)

An alternate method for label clearing can be performed from the "Ready" light at block **196**. The operator may enter the specific label he wishes to deactivate, and the program advances rough blocks **198**, **200** and so forth to block **244** where the "Ready" light is flashed. Instead of entering a channel number, as done during label programming, the operator enters the value "0,0". The program sets the marker value for the corresponding programmed label RAM address to zero, block **282**, and clears the label and channel number at block **284** by entering zero values. The "Done" light is then illuminated for three seconds at block **252**.

The label programming routine in progress may be exited by pressing the "Clear" key as shown at block **286**, which interrupts the program and returns to the "Ready" light at block **196**. When the "Ready" light is illuminated, pressing the "Clear" key at block **288** will cause the program to be exited, block **290**.

Tuning of television channels, including the use of stored labels or programmed labels, may be accomplished using the program shown in flowchart form in FIG. **6**. The program begins at block **320** with the entry of a keystroke sequence by the operator using the keypad, followed by the "Enter" key at block **321**. An entered value may correspond to one, two, three or more keystrokes.

At block **322**, a determination is made whether the entered keystroke sequence (hereinafter called the "input label") is the same as any of the stored programmed labels. (It is possible the operator may have stored, for example, a programmed label comprised of one or two keystrokes.) If there is no match, the program next checks at block **324** whether the input label corresponds to a numerical value of less than **200**. As can be seen by reference back to FIG. **3**, number key "1" of alpha/numeric keys **46** has no alphabetic characters associated therewith. As a result, the program recognizes a one or two digit value, or three digit value between 100 and 199 as a directly-selected channel. The program moves to block **326**, where instructions to tune the entered channel number directly are transmitted by the controller. (Television receivers currently commercially available typically provide for channel selection through channel "125". Also, this assumes no programmed label of the input value has been stored.)

If an input value of 200 or greater is entered, or a value which corresponds to a programmed label is entered, the program proceeds to block **330** where the marker count is set to zero, and at block **332** where the ROM address counter is set to "1". At block **334**, the program determines whether the current ROM address (address "1") has a marker value of "1" associated therewith. If not, the program checks at block **335** as to whether the current ROM address is the last ROM address (i.e., in the preferred embodiment when the ROM address equals forty-eight). If not, the address is incremented at block **336**, and the program returns to block **334** to determine whether this next ROM address has an associated marker bit value of "1".

When a marker bit value of "1" is identified at block **334**, the marker bit count is incremented, block **338**, and a determination is made at block **340** whether the value at the current ROM address is equal to the input label. If not, a determination is made at block **335** whether the current ROM address is the last ROM address. Provided the current address is not the final ROM address, the address is incremented at block **336** and the program returns to block **334**.

In the event the contents of the current ROM address is equal to the input label, the program uses the current marker count to retrieve the channel number from the corresponding RAM address, shown at block **344**. An instruction to the television to select the channel is transmitted, block **346**.

Returning to block **335**, in the event all ROM addresses have been reviewed without locating a corresponding, activated stored label, the program proceeds to block **348** where the programmed label RAM address is set to "1". (The current marker count value is retained.) At block **350**, a

check is made to determine whether the corresponding marker bit for this address has a bit value of "1", and if not, the program advances to block **351** where it is determined whether the current address is the last RAM address (i.e., in the preferred embodiment, RAM address "10"). If not, the address is incremented, block **352**, and the program returns to block **350** to make a determination for the next memory address. If an activated marker bit is found, however, the marker count is incremented, block **354**, and the program at block **356** determines whether the contents of the current memory address equal the input label. If not, a determination is made as to whether the current address is the last address, block **351**, and if it is not, the address is incremented at block **352** and the program returns to block **350**.

In the event the current address contents equal the input label, the program at block **360** uses the current marker count to retrieve the channel number from the corresponding RAM address. An instruction to the television to select the channel is transmitted, block **362**.

If all addresses are reviewed without a matching programmed label being found, then from block **358** the program proceeds to block **364** where the "Memory Full/Error" light is illuminated for three seconds, whereafter the program is ready for and awaits new input, block **366**.

Another feature of the television controller of the present invention is the provision of "Favorite Channels." This feature comprises a shortened scanning list of the ten (or fewer) favorite or most watched channels of the television operator. Rather than scroll through each available channel when reviewing available programming, the operator may scroll through the shortened list.

In a preferred embodiment of the present invention, up to ten favorite channels may be stored as described in derail herein. During television tuning, operation of the favorite channel scroll is performed in a manner similar to that typically used for conventional scanning operations. A scanning marker value may be used to retain the current address value corresponding to the current position within the scan. Actuation of the favorite channel ("FC") scan up key causes the marker value to be incremented and the next channel stored in memory will be displayed on the television. Actuation of the FC scan down key decrements the marker value to the next preceding channel stored in memory. Provision may be made to skip over any addresses which are empty.

The program for selecting channels for inclusion in the favorite channel scan may be seen in flowchart form in FIG. **7**. The operator presses the "PGM" key at block **370**, followed by a "favorite channel" function key, which in the preferred embodiment is an alternate function for the videorecorder "FAST FORWARD" key, as shown at block **372**. At block **374**, the program determines whether the memory is full, i.e. in the preferred embodiment, whether ten favorite channels have already been stored. In the event less than ten such channels have been programmed, the "Ready" light is illuminated at block **376**.

The operator may enter a channel number desired for inclusion in the FC memory at block **378**, followed by the enter key at block **380**. A determination is made at block **382** by reviewing the memory contents whether the input channel number has been previously programmed. If so, the program advances to block **384**, where the "Done" light is illuminated for three seconds. If not, the next available empty address in memory is found and the channel number is stored at that location, block **386**. The program then advances to block **384** and illumination of the "Done" light for three seconds. The program checks at block **388** to determine whether ten channels have now been stored, and if not, the program returns to the "Ready" light at block **376**.

If the determination made at either blocks **374** or **388** indicate that the memory is full, the program advances to block **390** where the "Memory Full/Error" light is illuminated. Further additions of channels to the FC scan can them only be accomplished after deleing one or more of the stored channel number values.

Channels may be deleted from the FC scan from either the "Ready" light at block **376** or the "Memory Full/Error" light at block **390**. In either case, the operator presses either of the FC scan keys, shown at block **392**. The program determines whether any channels are stored in memory, block **394**, and if not, returns to the "Ready" light at block **376**. If one or more channel numbers are stored, however, the an instruction to display the next channel in the FC scan is transmitted, block **396**. The operator may now choose to delete the current channel from the scan, in which case the "Clear" key is pressed, block **398**, and the displayed channel is deleted from the FC scan memory at block **400**. The program then returns to the "Ready" light at block **376**.

Alteratively, from block **396**, the operator may chose not to delete the displayed channel. Pressing either FC scan key, block **402**, will advance the scan (in the selected direction) and return the program to block **396** where the next channel is displayed.

In the event the "Enter" key is pressed at block **396**, as shown by block **403**, the program returns to the "Ready" light, block **376**, without deleting the displayed channel from memory. (In an alternate embodiment, pressing any key other than the "Enter" key at block **396** returns to the "Ready" light at block **376**.)

The program may be interrupted anytime by pressing the "Clear" key. Pressing the "Clear" key, block **404**, returns the program to the "Ready" light at block **376**. Pressing the "Clear" key again, or pressing the "Clear" key for the first time in the event the program is already at the "Ready" light, at block **406**, causes the FC program to be exited, block **408**. In addition, pressing the "Clear" key while the program is at block **390**, the "Memory Full/Error" light, also exits the program.

Finally, in the event the program is at a block where operator input is required, the program will be exited if no key is depressed for a period of fifteen seconds.

In the embodiment described in detail herein, only a single favorite channel scan is provided. However, it will be recognized by those skilled in the art that multiple favorite channel scans may be provided using a program similar to that shown in FIG. **7**. In such a case, additional keys may be provided on the remote controller for the selection of the particular scan to be used.

Also in the preferred embodiment, channel additions to the favorite channel scan are entered in the next available memory location, so that the operator has no programmable control over the specific position in the scan order a particular channel will occupy. However, the program may be modified, as will be understood by those skilled in the a, to create an open memory location at the current scan Location for the system. Memory reorganization to accomplish this task can be performed in a manner generally similar to that described in connection with Table III herein.

As a further feature of the present invention, a "short list" scan may be provided in which up to four channels may be stored for use in quickly moving between a small number of channels, such as when several programs are being monitored simultaneously. While channels are retained in the short list for scanning until they are deleted or overwritten

by other channels, the short list is suited for the temporary storage of several channels of current interest.

The programming of channels into the short list may be seen by reference to the flowchart of FIG. **8**. Programming can be carried out provided the controller flows the channel to which the television is currently tuned. In the event the control system described herein is built into a television receiver, it will be generally possible for the system to know at all times to which channel the receiver is tuned. However, in the case of a universal remote controller as in the preferred embodiment, where a conventional channel scan operation is performed, the controller will not know which channel is tuned. In typical channel scans, for example, it is common for the receiver to program certain channels which do not receive transmissions to be skipped during scanning. Because this information is programmed into he receiver and not the remote, a remote controller will not know which channels may have been skipped.

In the preferred embodiment, the controller will know which channel the receiver is tuned to in the case of direct tuning by channel number, or in the case of tuning by either stored or programmed labels. Also, the controller will know the channel in the case of favorite channel scans, or short list scans as described herein below.

Upon deciding to add a channel to the short list scan, the operator presses the "+CH" key, shown as key **74** on keypad **36** in FIG. **3**. Pressing this key, shown at block **410** in FIG. **7**, causes the system to inquire at block **411** whether it knows the current channel of the television receiver. If not, the "Memory Full/Error" light is illuminated for three seconds, block **413**, and the program routine is ended, block **415**.

If the channel number is known, that channel number is inserted at block **412**. A review of the channels currently in the short list memory is made at block **414**, and in the event the channel number is found, it is deleted by entering a value of zero into the corresponding memory location, block **416**.

In the event the channel is not already stored, or following its deletion, a check is made to determine whether the first short list memory position is open, block **417**. If not, a check is made of the second position, block **418**, and if the position is not open, the third position at block **420** and then the fourth position at block **422** are checked. In the event the first memory position is open, the current channel is stored at that position, block **424**. If not open, and if the second position is open, the contents of the first position is moved to position two, block **426**, and the channel is stored in the first position. Similarly, if the third position is open, the contents of the first and second positions are moved to positions two and three, respectively, blocks **428** and **430**, with the channel again being stored in position one. If the fourth position is open, the memory contents are moved one position to open the first position, where the current channels is stored, as shown at blocks **426**, **428** and **430**.

If all memory positions are full, then the channel contained in the fourth position is deleted, block **432**, and the channels are moved as has been described to enable the current channel to be stored in position one.

It can therefore be seen that storage of channels in the short list is performed in a "first-in/first-out" manner, with the latest channel stored occupying the first memory position. The earliest channel stored is automatically deleted if a fifth channel is attempted to be stored.

It is possible to delete specific channels from the short list, the program for performing the deletion being included in the program for channel selection using the short list shows in flowchart form in FIG. **9**. The program is made functional upon pressing of either of the short list scan keys **76** and **78** in keypad **36** (see FIG. **3**). Upon pressing the scan key, block **434**, the system determines whether the keystroke preceding the scan key was another actuation of the short first scan keys, block **435**. If so, it is necessary to advance the short list pointer to the next scan position, shows at block **436**, since it win be desired to advance to the next stored channel. However, is the event the preceding channel selection keystroke was some other key, indicating that the operator selected a channel outside the short list, it will be desired to return to the same channel within the short list. Thus, in this case, block **436** is bypassed.

This scan pointer "advance" is in the up direction when the scan-up key is depressed, and in the down direction when the scan-down key is depressed. Memory positions four and one are considered to be adjacent for scanning purposes.

A check is made at block **438** to determine whether the current memory position is empty. In the event it is not, the channel number is retrieved and an instruction to tune to the channel is transmitted, block **440**. However, if the memory position is empty, the program determines at block **442** whether the scan pointer is at position one. Recalling that in storing channels, all positions are filled from position one up, that position can be empty only if the entire short list memory is empty. Thus, a determination at block **442** that the pointer is at position one indicates an empty memory, and no channel change occurs, block **444**. The program is then ended, block **445**.

If the pointer is not at position one when an empty memory position is found, the program proceeds back to block **436** where the pointer is incremented and the next memory position is reviewed at block **438**.

In addition to deletion caused by entry of a fifth channel into the short list, channels may be deleted from the short list as shown in FIG. **9**. Once a channel is tuned at block **440**, the operator may press the "—CH" key, shown at **80** of keypad **36** in FIG. **3**, as indicated at block **446**. The memory entry at the current position is deleted, block **448**. A determination is made whether the scan pointer is currently at position four, block **450**. If not, all entries at positions higher that the current position are moved down, block **452**, with the result that the vacant memory position is moved to position four. A check is made at block **454** to determine whether the current memory position is empty, and if not, an instruction to tune the channel stored at the current position (formerly at the next higher memory position) is transmitted, block **456**.

If the determination at block **454** indicates that the current memory position is empty, it signifies that the just-deleted memory entry was in the highest filled memory position. The program then proceeds to block **458**, where the scan pointer is moved to position one. Also, the program moves to block **458** in the event the determination at block **450** shows the current position where the channel number has been deleted to be position four. The program then checks to determine whether memory position one is empty, block **460**, and if not, displays that channel on the television, block **456**. In the event memory position one is empty, no channel change occurs, block **444**, indicating that the short list memory is empty.

One further feature of the present invention relates to the keys used to select the particular device to be controlled. As is commonly known in the art, the remote control unit of the present invention is capable of controlling several devices, such as a television, videorecorder and cable box. In addition, the controller may be of the "universal" coded type, typically capable of controlling six or more such

devices from a variety of manufacturers. Located in ROM is preprogrammed data sufficient to translate the keystrokes entered on the keypad into the property encoded transmitted signals to which a device from a particular manufacturer or a device of a particular model will respond. (This "coded" remote is in contrast to a "learning" remote in which the encoded signals must be learned from signals transmitted from another control device. Such devices are typically unprogrammed for any device until such time as they are "taught" from the other device.)

In use, again as commonly understood in the art, a program is provided whereby the operator may select from a plurality of programs the specific code sequences for the device in question. The selection is typically made by entering one or more characters representative of the device and/or manufacturer.

In addition, during use of the controller, the operator may switch the device from controlling, for example, a television to a videorecorder, by pressing the appropriate device selection key **67** (see FIG. **3**). This causes the transmission format of the controller to be changed to be compatible with the selected device until another of the device selection keys is depressed.

In currently known controllers having preprogrammed device controlling keys, it is possible for the operator to inadvertently actuate a device selection key without realizing this has been done. This is particularly a problem if the accidentally selected device is one not in use by the operator, for example actuating the cable box selection key when no cable box is present. This is because further actuation of keys on the controller will seem to the operator to have no effect. The operator may have difficulty identifying the cause of this situation, and may assume (incorrectly) that the controller is not properly functioning.

In accordance with the present invention, in one embodiment of the invention, a "deselection" code is provided for each of the device selection keys in addition to the transmission formats available for various manufacturers. Thus, while the operator may enter a code to program the device to emit control signals compatible with for example a particular model of cable box, the operator may enter a code indicative of the absence of a cable box entirely. Entry of such a code deactivates the device selection key (for the cable box in this example), so that upon pressing the cable box key, the device continues to send out control signals that can be interpreted by the equipment previously selected. Thus, accidental pressing of a device selection key has no effect on the further operation of the control device. Further, the device may be manufactured with the deserection code Initially programmed for all selectable pieces of equipment. In this way, it is not necessary for the operator to do anything to insure that unused keys are unprogrammed.

It will also be readily recognized that other data items may be programmed by the control device manufacturer into the ROM if desired. For example, it may be desired to provide a display legend corresponding to each of the stored labels that will give to the operator a readable channel identification word or phase on the screen upon channel selection. Thus upon selection of "HBO" by entering keystrokes "4, 2, 6", a display entry in ROM containing the alphabetic characters "HBO" may be retrieved from ROM at the same time the label entry in ROM is identified (see block **116** in FIG. **4**). Of course, it will be recognized that the label can be anything capable of being stored and displayed, and may be different from the nominal alphabetic equivalent of the stored label (e.g., "HOME BOX OFFICE" in the above example).

Also, it will be recognized that the marker bit technique described herein for finding correspondence between labels stored in ROM and channel numbers stored in RAM may be used in a reverse direction to find entries in ROM that correspond to channel numbers in RAM. For example, suppose that HBO is received by the television on channel "3" and stored in ROM is the display legend "HBO". As previously described, entry of the keystrokes "4, 2, 6" will cause the television to tune to channel "3" and the legend "HBO" to be displayed on the screen. However, in the event the operator directly selects channel "3", the control device may be programmed to review the channel number RAM to determine whether channel "3" has been stored. On finding the channel number, the RAM address can be used to count through the marker bits to determine the corresponding ROM address. The "HBO" legend can then be retrieved from ROM for display on the television screen.

The manner in which the device software can be programmed for this operation will be readily understood by those skilled in the art.

This technique may be used for other data stored in ROM. For example, in controlling a videorecorder using the device described in U.S. Pat. No. 5,307,173 (such devices being commercially sold under the trademark "VCR+") in which a compressed code contains time, date, channel and duration information concerning the program to be recorded, a channel conversion may be required as previously described. For most of the available program networks, the manufacturer of commercially available devices made in accordance with tis patent has assigned "defined" channel numbers used on a nationwide basis. Thus, in the commercially-available system, HBO requires a conversion to channel "33" for the compressed code to be understood. This conversion data may be stored in the ROM of the present invention and retrieved in the manner described above. Such a technique will greatly reduce the necessity for initial configuring of a control system incorporating the feature of U.S. Pat. No. 5,307,173. In the event both labels and conversion data for this system are stored in ROM, selection of labels for channels will automatically set up the configuration for these channels, and vice versa.

In another feature which may be used with the present invention, the RAM includes a data buffer into which the numeric keystroke sequence most recently entered is captured. This sequence is retained until another numeric key or any other channel-changing key is pressed, and all other key actuations are ignored. Thus, in the event a channel selection is made while the remote control is not being properly pointed at the television receiver, or in the event transmission range is reduced due to obstacles or weak batteries, the operator may simply press the "Enter" key to resend the keystroke sequence. The sequence itself need not be reentered.

While the embodiments described herein constitute preferred embodiments of the present invention, it should be recognized that changes and variations may be made therein without departing from the scope of the present invention, which is defined in the appended claims.

What is claimed is:

1. Apparatus for controlling a television receiver to select a television channel corresponding to a preassigned channel number, the apparatus comprising:

a read-only memory for storing a plurality of predetermined stored labels, each of said stored labels being stored at one of an ordered series of predetermined ROM address;

a programmable memory including a plurality of RAM addresses, each of said RAM addresses being capable of storing one channel number thereat, said programmable memory being further adapted to store a marker value corresponding to each of said ROM addresses;

an operator-actuated control for generating a first signal comprising a data set representative of one of said stored labels and a channel number to be associated therewith;

a processor for receiving said first signal, and responsive thereto, causing an activation value to be stored for the one of said marker values corresponding to the one of said ROM addresses corresponding to said one stored label, and for counting the number of said activation values corresponding to said ROM addresses preceding said one stored label, and for storing said channel number at the one of said RAM addresses corresponding to said count;

said operator-actuated control further generating a second signal comprising a data set representative of said one stored label independent of said channel number;

said processor, upon receiving said second signal, retrieving from said programmable memory said channel number by counting the number of said activation values corresponding to said ROM addresses preceding said one stored label and retrieving said channel number from the one of said RAM addresses corresponding to said count, and generating an output control signal corresponding to said channel number.

2. Apparatus as defined in claim 1, wherein said marker value includes a marker data bit, and wherein said activation value includes a value for said marker bit of one.

3. Apparatus as defined in claim 1, wherein prior to storing of said channel number at the one of said RAM addresses corresponding to said count of said activation values, and in the event another channel number is already stored at said RAM address, said processor moves said another channel number and any further channel numbers stored at subsequent ones of said RAM addresses to the next succeeding one of said RAM addresses.

4. Apparatus as defined in claim 1, wherein said control further generates a third signal representative of an instruction to disassociate said channel number from said stored label, and said processor upon receiving said third signal removes said channel number from said programmable memory.

5. Apparatus as defined in claim 1, wherein:

said control further generates a third signal representative of an instruction to disassociate said channel number from said stored label;

said processor upon receiving said third signal causes said activation value to be deleted for said one marker value, and removes said channel number from said RAM address of said programmable memory.

6. Apparatus as defined in claim 5, wherein subsequent to removing of said channel number at the one of said RAM addresses corresponding to said count of said activation values, and in the event another channel number is stored at a subsequent one of said RAM addresses, said processor moves said another channel number and any further channel numbers stored at subsequent ones of said RAM addresses to the next preceding one of said RAM addresses.

7. Apparatus as defined in claim 1, further comprising a transmitter for transmitting said control output signal to a television receiver.

8. Apparatus as defined in claim 1, wherein said stored labels each comprise a unique series of characters, said control includes means for actuation in a manner representative of a series of characters, and wherein said processor upon receipt of said second signal which is representative of a series of characters, some consecutive portion of which corresponds to one said stored label, ignores any characters not corresponding to said stored label and generates said output control signal.

9. Apparatus as defined in claim 8, wherein said consecutive portion of said series of characters is an initial portion of said series.

10. Apparatus as defined in claim 1, wherein said stored labels each comprise a unique series of characters, said control includes means for actuation in a manner representative of a series of characters, and wherein said read only memory stores in association with each said stored label a first data entry indicative of whether said stored label is an absolute stored label, and wherein said processor upon receipt of said second signal representative of a series of characters, some consecutive portion of which corresponds to one said stored label other than one of said absolute stored labels, ignores any characters not corresponding to said stored label and generates said output control signal.

11. Apparatus as defined in claim 1, wherein:

said programmable memory further is for storing at least one programmed label;

said control generating a third signal comprising a data set representative of a programmed label and a second channel number to be associated therewith;

said processor, in response to said third signal, causes said programmable memory to store said programmed label and said second channel number as corresponding thereto;

said data set of said second signal being selectively representative of one of said programmed labels;

said processor, upon receiving said second signal, retrieves from said programmable memory said channel number corresponding to said programmed label and generates an output control signal corresponding to said channel number.

12. Apparatus as defined in claim 11, further comprising an error indicator, and wherein said processor, in response to said third signal, determines whether said programmed label is identical to any of said stored labels, and in such event, activates said error indicator without causing said programmed label to be stored in said programmable memory.

13. Apparatus for controlling a television receiver as defined in claim 11, wherein:

each of said stored labels is stored in said read-only memory at one of an ordered series of predetermined ROM address;

said programmable memory includes a plurality of RAM addresses, each of said RAM addresses being capable of storing one of said channel numbers thereat;

said programmable memory stores a marker value for each of said ROM addresses;

upon receipt of said first signal, said processor causes an activated value to be stored for the one of said marker values corresponding to the one of said ROM addresses corresponding to said one stored label, and counts the number of said activation values corresponding to said ROM addresses preceding said one stored label and stores said channel number at the one of said RAM addresses corresponding to said count;

upon receipt of said second signal, said processor retrieves said corresponding channel number by count-

ing the number of said activation values corresponding to said ROM addresses preceding said one stored label and retrieving said channel number from the one of said RAM addresses corresponding to said count.

14. Apparatus as defined in claim 13, wherein:

said programmable memory further includes a plurality of RAM label addresses, each of said RAM label addresses being capable of storing one of said programmed labels thereat;

said programmable memory further stores one of said marker values for each of said RAM label addresses;

upon receipt of said third signal, said processor causes an activated value to be stored for the one of said marker values corresponding to the one of said RAM label addresses corresponding to said one programmed label, and counts the number of said activation values corresponding to all of said ROM addresses and to said RAM label addresses preceding said one programmed label and stores said channel number at the one of said RAM addresses corresponding to said count;

upon receipt of said second signal, in the event said second signal is representative of one of said programmed labels, said processor retrieves said corresponding channel number by first counting the number of all of said activation values corresponding to said ROM addresses and then counting the number of said activation values corresponding to said RAM label addresses preceding said one programmed label and retrieving said channel number from the one of said RAM addresses corresponding to said count.

15. Apparatus as defined in claim 14, wherein said programmable memory includes a maximum number of RAM addresses and a maximum number of RAM label addresses, and wherein the maximum number of useable stored labels having activation values associated therewith is equal to said maximum number of RAM addresses less the number of programmed labels having activation values associated therewith.

16. Apparatus as defined in claim 15, wherein said programmable memory includes a maximum number of RAM label addresses, said maximum number of RAM label addresses being less than said maximum number of RAM addresses.

17. An apparatus for controlling a television receiver to select a television channel corresponding to a preassigned channel number, the apparatus comprising:

a control for generating a first signal representative of a selected channel;

a processor for receiving said first signal, and responsive thereto, generating an output control signal corresponding to a selected channel number for instructing a television receiver to tune to said selected channel;

a programmable memory including a predetermined number of channel addresses for storing up to said predetermined number of channel numbers;

a storage control for generating a second signal, said processor receiving said second signal, and responsive thereto and subsequent to generating said output control signal, causing said programmable memory to store said selected channel at a first of said channel addresses;

upon receipt of said second signal, and in the event any other of said channel numbers are stored in any of said channel addresses, and prior to storing said selected channel number, moving said other channel numbers to the next succeeding higher of said channel addresses and erasing any of said other channel numbers already stored at the last of said channel addresses;

a retrieval control for generating a third signal, said processor receiving said third signal, and responsive thereto, retrieving from one of said channel addresses the one of said channel numbers stored thereat and generating an output control signal corresponding to said first selected channel number.

18. Apparatus as defined in claim 17, wherein said processor, upon receiving a subsequent one of said third signals retrieves the one of said channel numbers stored at a next succeeding one of said channel addresses.

19. Apparatus for controlling a television receiver to select a television channel corresponding to a preassigned channel designation, the apparatus comprising:

a read-only memory storing a plurality of predetermined stored labels in an ordered series of ROM addresses;

a programmable memory for storing one of said channel designations at each of a predetermined number of RAM addresses, and for storing a marker value for each of said ROM addresses;

a control for generating a first signal comprising a data set representative of a selected one of said stored labels and a channel designation to be associated therewith;

a processor for receiving said first signal and responsive thereto, a) storing a marker value for the one of said ROM addresses corresponding to said label, b) beginning with a first of said ROM addresses, counting all of said ROM addresses to have marker values stored therefor up to and including said marker value stored for said selected label, and c) storing said channel designation at the one of said RAM addresses corresponding to said count.

20. An apparatus as claimed in claim 19, wherein:

said control generates a second signal comprising a data set representative of one of said stored labels independent of said channel designation associated therewith; and

said processor receiving said second signal and responsive thereto, a) beginning with a first of said ROM addresses, reviewing each of said stored labels until one of said stored labels matching said second signal is found, b) beginning with a first of said ROM addresses, counting all of said ROM addresses to have marker values stored therefor up to and including said marker value stored for said matching label, and c) retrieving from the one of said RAM addresses corresponding to said count the channel designation stored therein and causing the television receiver to select the television channel corresponding to the retrieved one of said channel designations.

21. Apparatus for controlling a television receiver to select a television channel corresponding to a preassigned channel designation, the apparatus comprising:

a read-only memory storing a plurality of predetermined stored labels in an ordered series of ROM addresses;

a programmable memory for storing one of said channel designations at each of a predetermined number of RAM addresses, and for storing a marker value for each of said ROM addresses;

a control for generating a first signal comprising a data set representative of a selected one of said stored labels and a channel designation to be associated therewith;

a processor for receiving said first signal and responsive thereto, a) storing a marker value for the one of said ROM addresses corresponding to said label, b) beginning with a first of said ROM addresses, counting all of said ROM addresses to have marker values stored therefor up to and including said marker value stored for said selected label, c) determining in accordance with a first formula, one of said RAM addresses as corresponding to said count, and d) storing said channel designation at said one of said RAM addresses.

22. An apparatus as claimed in claim 21, wherein:

said control generates a second signal comprising a data set representative of one of said stored labels independent of said channel designation associated therewith; and

said processor receiving said second signal and responsive thereto, a) reviewing each of said stored labels in said ROM addresses until one of said stored labels matching said second signal is found, b) beginning with a first of said ROM addresses, counting all of said ROM addresses to nave marker values stored therefor up to and including said marker value stored for said matching label, c) determining in accordance with said first formula, one of said RAM addresses as corresponding to said count, and d) retrieving from said one of said RAM addresses the channel designation stored therein and causing the television receiver to select the television channel corresponding to the retrieved one of said channel designations.

* * * * *

US005754960A

United States Patent [19]

Downs et al.

[11] Patent Number: 5,754,960

[45] Date of Patent: May 19, 1998

[54] **DISPLAY CONSOLE AND USER INTERFACE FOR MULTISITE RF TRUNKED SYSTEM**

[75] Inventors: **Stephen R. Downs; Charles P. Brame**, both of Forest; **Satish Kappagantula**, Lynchburg, all of Va.

[73] Assignee: **Ericsson Inc.**, Research Triangle Park, N.C.

[21] Appl. No.: **835,689**

[22] Filed: **Feb. 14, 1992**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 825,689, Feb. 22, 1991, Pat. No. 5,200,954.

[51] **Int. Cl.**[6] **H04B 7/00**

[52] **U.S. Cl.** **455/508**; 455/520; 381/123; 379/267

[58] **Field of Search** 455/15, 33.1, 53.1, 455/54.1; 379/59, 63, 203, 204, 267, 142; 340/721, 712; 381/123

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,611,301	10/1971	Parks	340/172.5
3,678,391	7/1972	Gough	325/55
3,809,910	5/1974	Walker et al. .	
3,971,000	7/1976	Cromwell	340/172.5
4,028,498	6/1977	Mehaffey et al. .	
4,251,865	2/1981	Moore et al.	364/200
4,286,118	8/1981	Mehaffey et al. .	
4,653,090	3/1987	Hayden	379/204
4,698,805	10/1987	Sasuta et al.	370/97
4,726,054	2/1988	Molnar .	
4,866,764	9/1989	Barker, III	379/368
4,901,314	2/1990	Lohrbach	371/11.2
4,924,496	5/1990	Figa et al.	379/142
4,926,495	5/1990	Comroe et al.	455/54
4,928,099	5/1990	Drake	340/825.28
4,947,162	8/1990	Kimura	340/825.08
4,961,070	10/1990	Maher et al.	340/721

(List continued on next page.)

OTHER PUBLICATIONS

Jones, "The Pye TVT Approach to Audio Controls Systems", International Broadcast Engineer, vol. 6, No. 122, pp. 4–6, 8–11, Mar., 1975.

Ullah, "Master Switching Control Panel for Broadcast Studics", ABV Technical Review (Japan), No. 69 (Jul. 1980).

Motorola Coverage Guide for Smartnet™ System Users (70 page brochure and Table of Contents (pp. 1–15).

Trunking Console System Functional Specification, Console Systems, Inc., Console System Electronics Section 2 (pp. 2–1–2–66).

Motorola Centracom Series II Plus brochure dated Jul. 1, 1988 (6 pages).

Motorola System Planner RC–2–37C, Mar., 1988, "Centracom Series II Control Centers" (pp. 1–42).

Motorola System Planner R4–2–73A, Jul., 1990, "Centracom Series II Plus Control Centers" (pp. 1–46).

Motorola, Inc. Centracom Series II Plus™ CRT Console Operator's Manual (pp. 1–40); Appendix A (pp. 1–6); Glossary (pp. 1–5).

GE C3™ Series, Overview and Introduction, Standard Practice #2.400–1002–01, Jul., 1988.

(List continued on next page.)

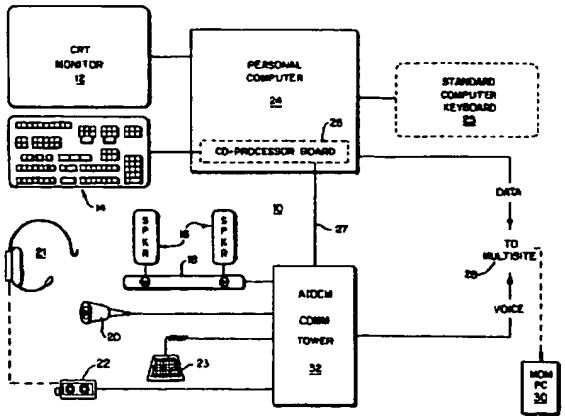
Primary Examiner—Edward F. Urban

Attorney, Agent, or Firm—Nixon & Vanderhye P.C.

[57] **ABSTRACT**

A dispatcher console for use in a digitally trunked, multisite public service radio system. The dispatcher counsel comprises a personal computer having a co-processor logic board, an audio switching tower, and user I/Os including a customized keyboard, display screen, audio speakers, headset and a transmit foot pedal. The switching tower routes audio communications between the console and multisite switch. The tower is controlled by and connected directly to the co-processor board. The customized keyboard is also connected directly to the co-processor board and has dedicated keys for commonly performed functions. The display screen presents information in a standard format such that the dispatcher knows precisely where to find particular information.

9 Claims, 9 Drawing Sheets



U.S. PATENT DOCUMENTS

4,964,157	10/1990	Aoshima	379/204
4,972,457	11/1990	O'Sullivan .	
4,991,197	2/1991	Morris .	
5,046,183	9/1991	Dorst et al.	379/96
5,101,502	3/1992	Felderman et al.	455/53.1
5,113,431	5/1992	Hora .	
5,130,662	7/1992	Jorgensen et al. .	
5,159,701	10/1992	Barnes et al.	455/54.1 X
5,169,342	12/1992	Steele et al.	345/146
5,175,866	12/1992	Childress et al.	455/34.1 X
5,200,954	4/1993	Teel, Jr et al.	455/33.1
5,223,844	6/1993	Mansell et al.	342/357
5,241,537	8/1993	Gulliford et al.	370/67
5,548,810	8/1996	Riddell et al.	455/89

OTHER PUBLICATIONS

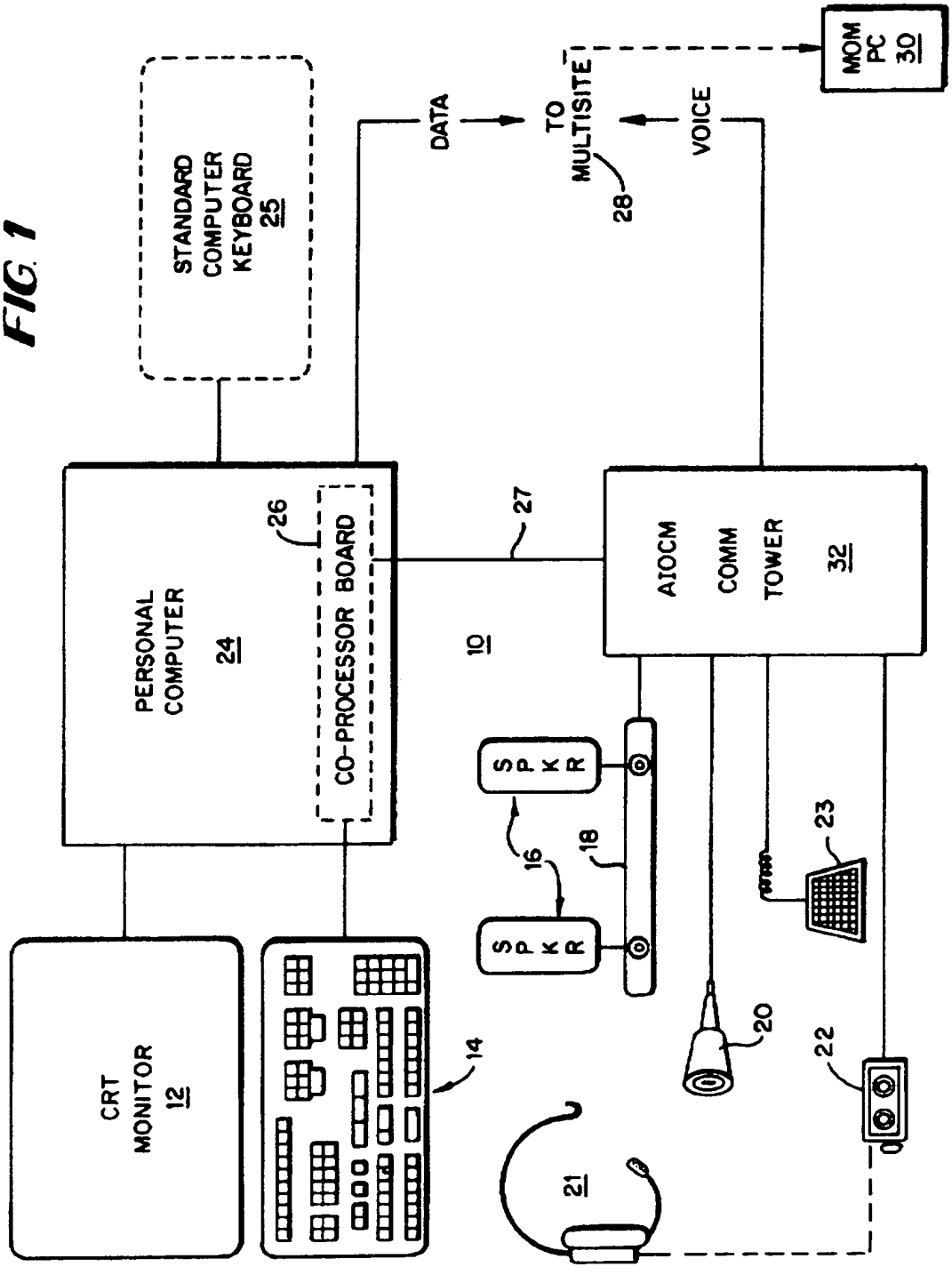
GE C3™ Series Console Dispatch Center. Standard Practice #2.403–1003–01. Jul., 1988.

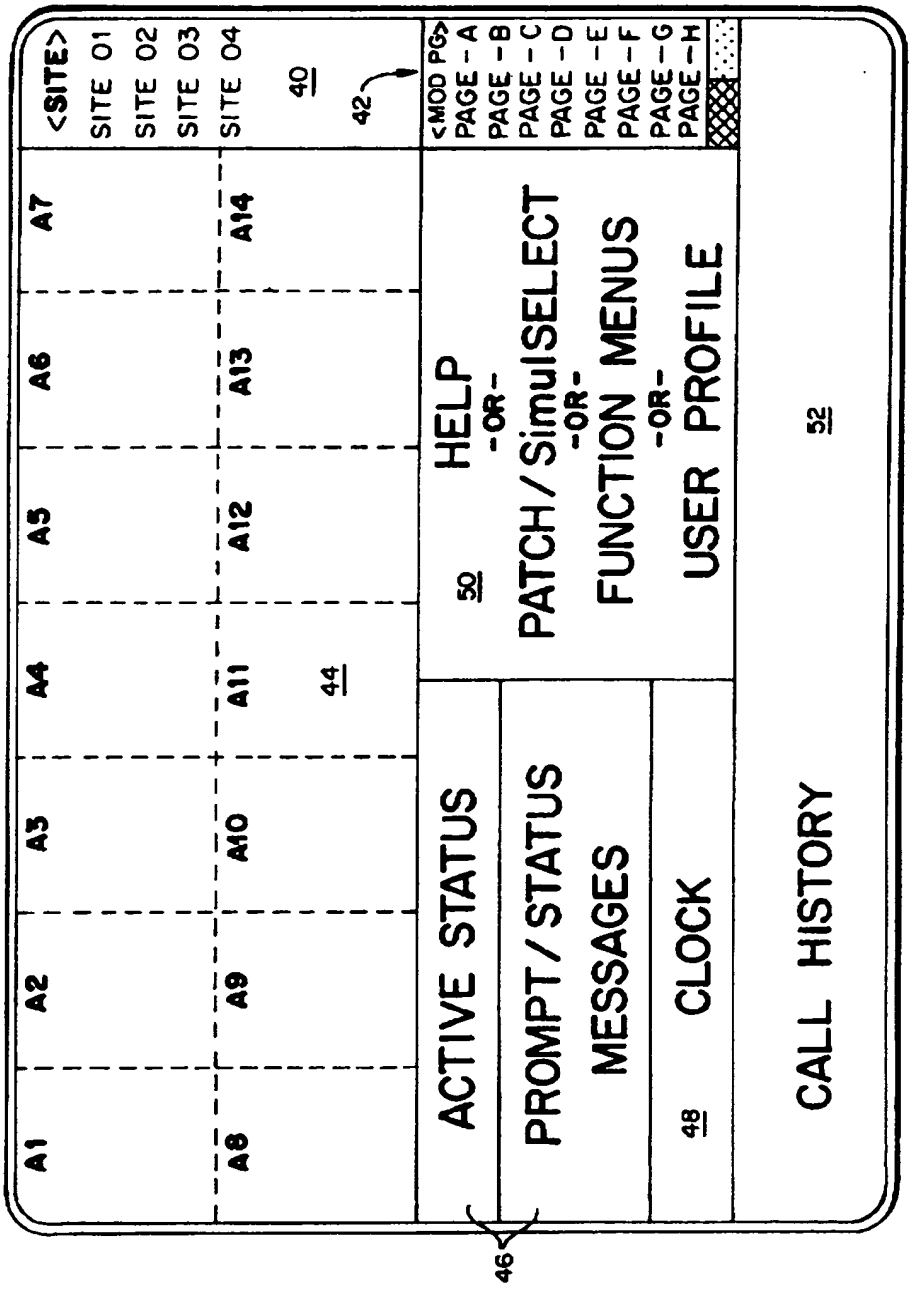
GE C3™ Series Maintenance and Administration Position (MAP) User Manual. Standard Practice #2.401–1004–01. Jul., 1988.

GE Mobile Communications C3™ Series Console 16 Plus®, Operators's Manual (LBI–31833A).

Ericsson GE Mobile Communications 16GEMS Multisite Coordinator Maintenance Manual (LBI–38456A).

FIG. 1


MOM PC 30
TO MULTISITE
28
DATA
VOICE
STANDARD COMPUTER KEYBOARD 25
PERSONAL COMPUTER 24
CO-PROCESSOR BOARD
26
27
AIOCM COMM TOWER 32
10
SPKR
SPKR
16
18
23
20
22
CRT MONITOR 12
14
21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SITE 01
SITE 02
SITE 03
SITE 04
40
42
<MOD PG>
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PAGE - B
PAGE - C
PAGE - D
PAGE - E
PAGE - F
PAGE - G
PAGE - H
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
44
HELP
-OR-
50
PATCH / SimulSELECT
-OR-
FUNCTION MENUS
-OR-
USER PROFILE
ACTIVE STATUS
PROMPT / STATUS MESSAGES
CLOCK
48
CALL HISTORY
52
12
46

FIG 2

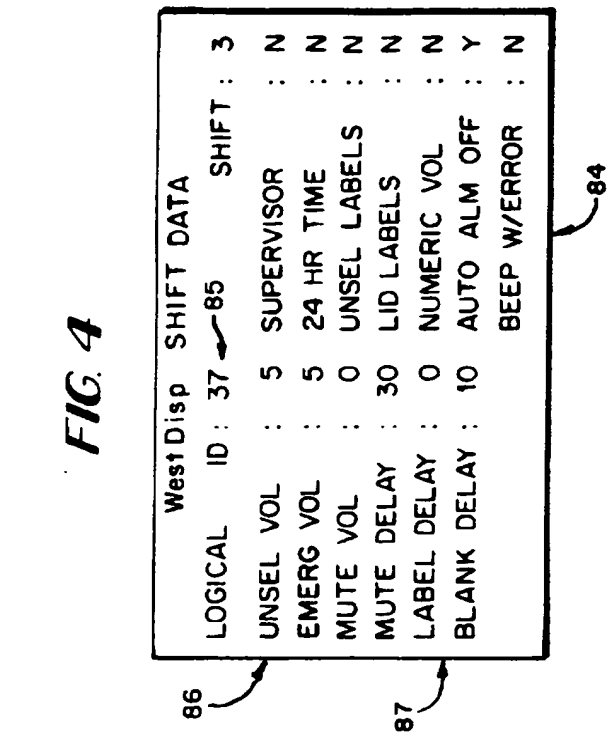


FIG. 4

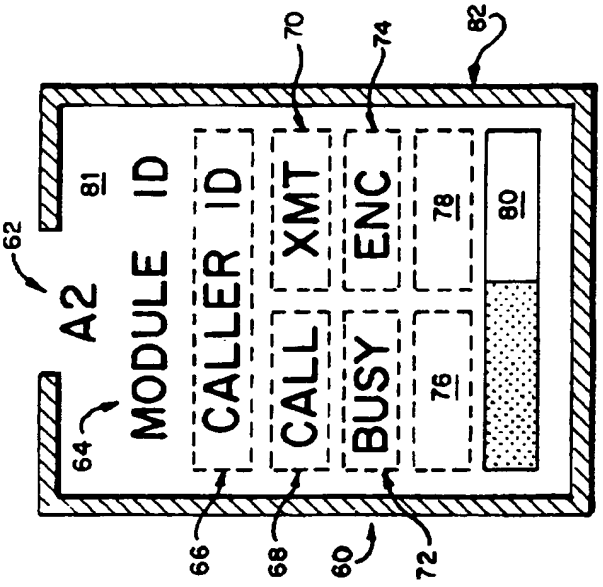


FIG. 3

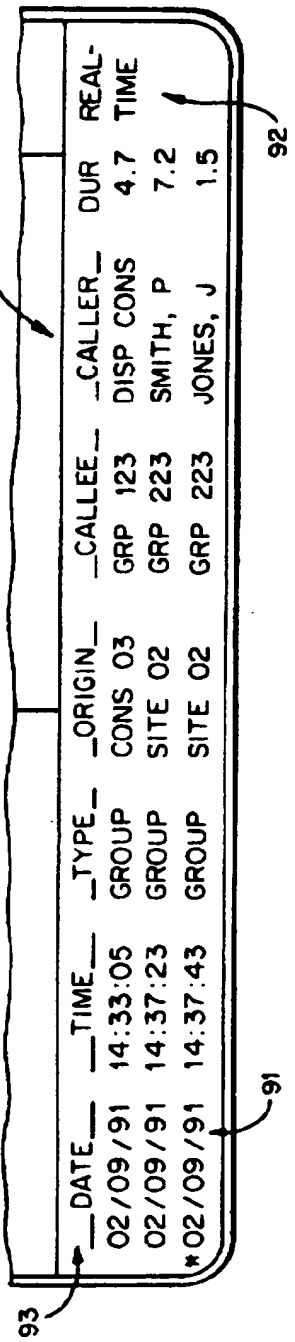
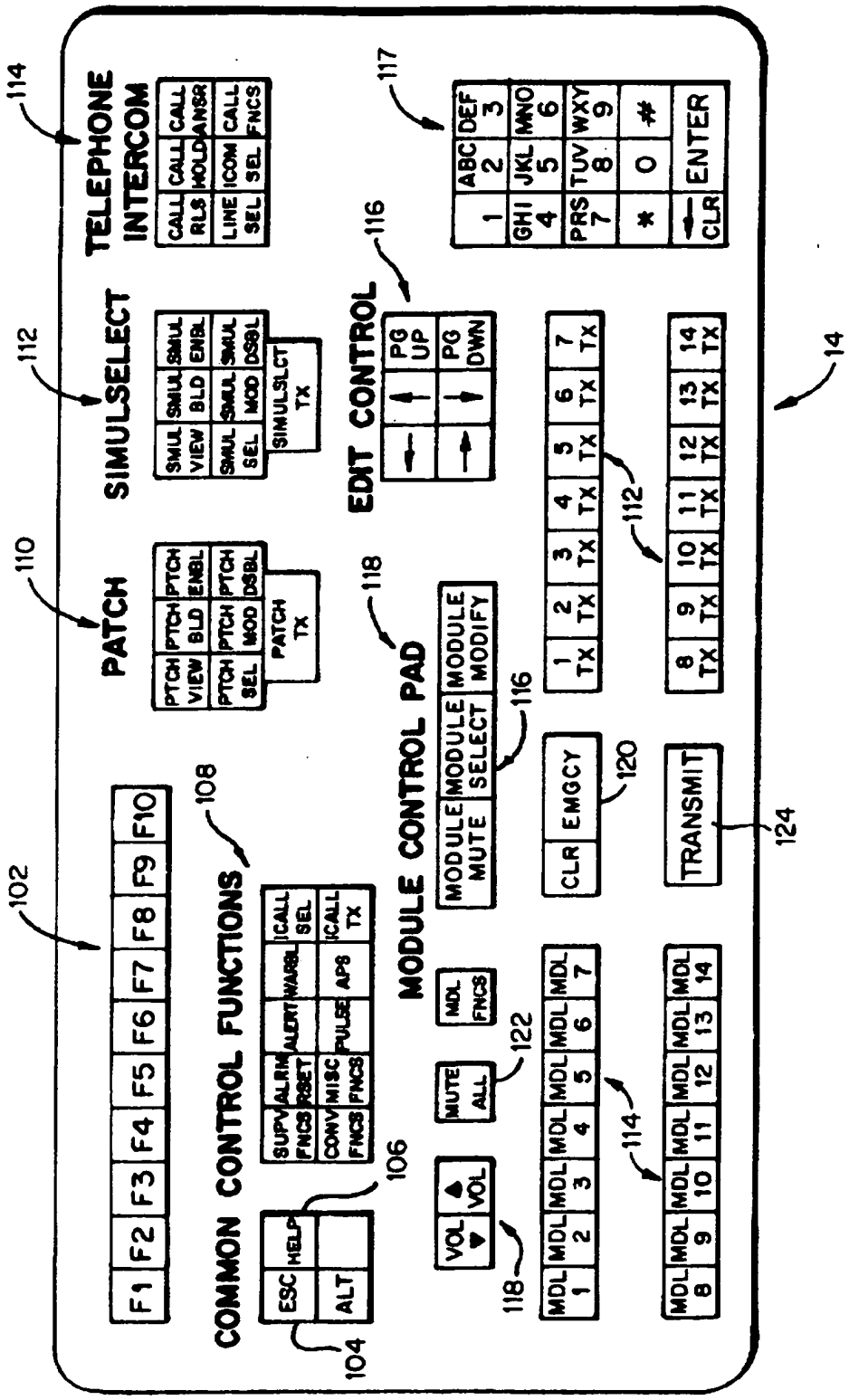


FIG. 5

FIG. 6


TELEPHONE INTERCOM
CALL RLS
CALL HOLD
CALL ANSR
LINE SEL
ICOM SEL
CALL FNCS
SIMULSELECT
SIMUL VIEW
SIMUL BLD
SIMUL ENBL
SIMUL SEL
SIMUL MOD
SIMUL DSBL
SIMULSLCT TX
PATCH
PTCH VIEW
PTCH BLD
PTCH ENBL
PTCH SEL
PTCH MOD
PTCH DSBL
PATCH TX
EDIT CONTROL
PG UP
PG DWN
DEF 3
ABC 2
JKL 5
MNO 6
GHI 4
PRS 7
TUV 8
WXY 9
*
0
#
CLR
ENTER
F1 F2 F3 F4 F5 F6 F7 F8 F9 F10
COMMON CONTROL FUNCTIONS
SUPV FNCS
ALRM RSET
ALERT
WARBL
PULSE
APS
ICALL SEL
ICALL TX
CONV FNCS
MISC FNCS
ESC
HELP
ALT
VOL
MUTE ALL
MDL FNCS
MODULE CONTROL PAD
MODULE MUTE
MODULE SELECT
MODULE MODIFY
CLR
EMGCY
TRANSMIT
MDL 1 2 3 4 5 6 7
MDL 8 9 10 11 12 13 14
1 TX 2 TX 3 TX 4 TX 5 TX 6 TX 7 TX
8 TX 9 TX 10 TX 11 TX 12 TX 13 TX 14 TX
102
104
106
108
110
112
114
116
117
118
120
122
124
14

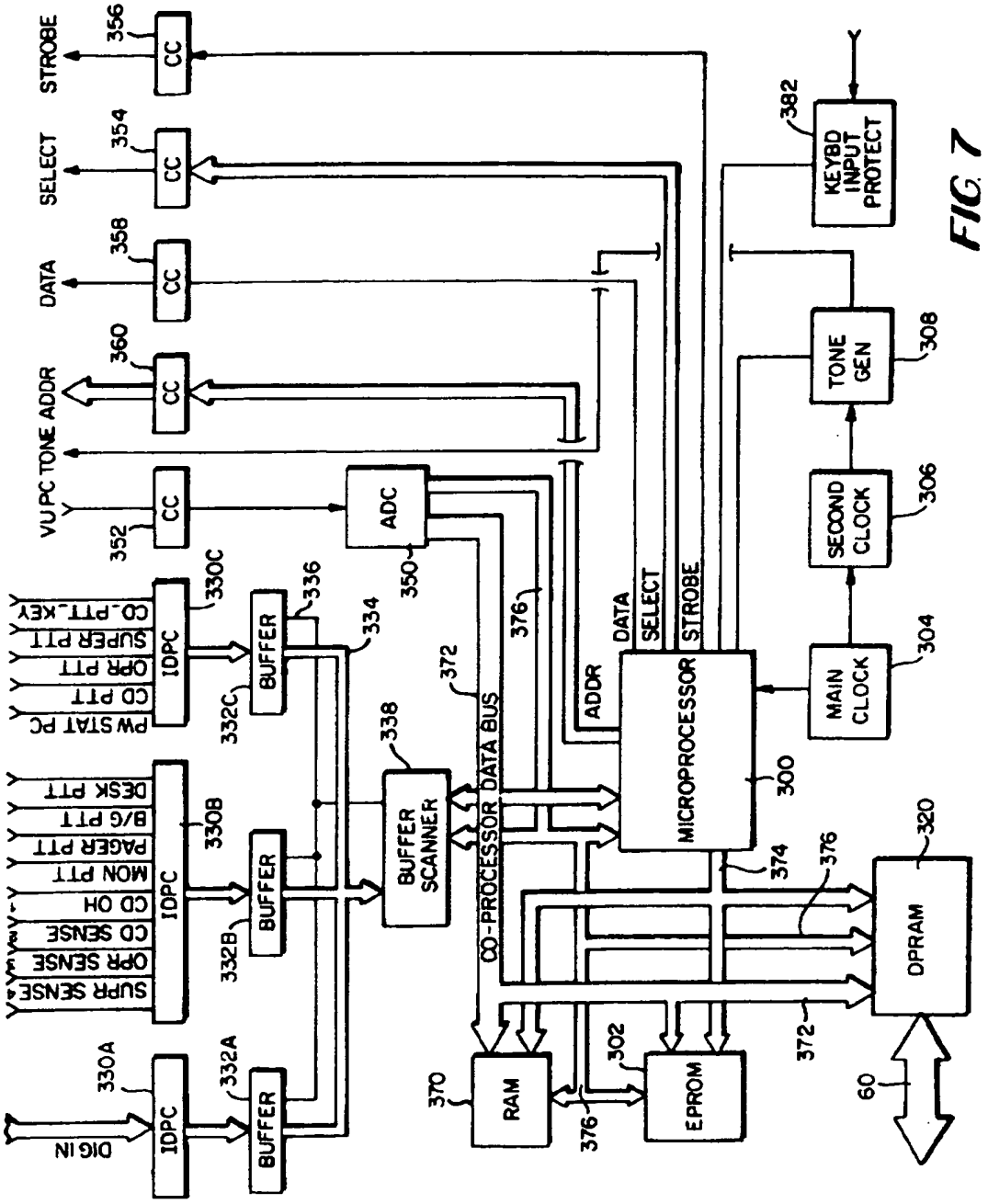
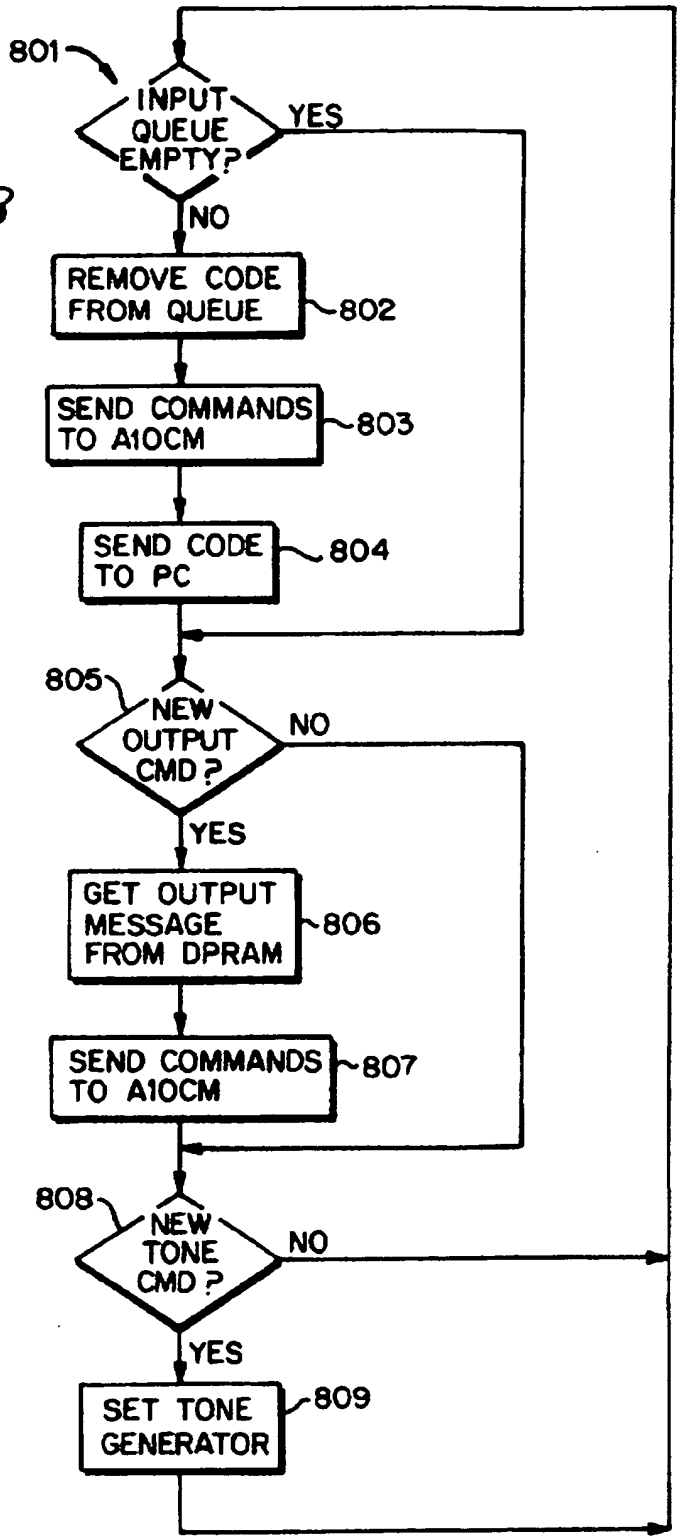

STROBE
SELECT
DATA
ADDR
VU PC TONE
CC
356
354
358
360
352
ADC
350
IDPC
330C
330B
330A
PW STAT PC
CD PTT
OPR PTT
SUPER PTT
CD PTT KEY
DESK PTT
B/G PTT
PAGER PTT
MON PTT
CD OH
CD SENSE
OPR SENSE
SUPR SENSE
DIG IN
BUFFER
332C
332B
332A
336
334
338
BUFFER SCANNER
372
376
CO-PROCESSOR DATA BUS
ADDR
DATA
SELECT
STROBE
MICROPROCESSOR
300
KEYBD INPUT PROTECT
382
TONE GEN
308
SECOND CLOCK
306
MAIN CLOCK
304
374
DPRAM
320
RAM
370
EPROM
302
60

FIG. 7

FIG. 8


801
INPUT QUEUE EMPTY?
YES
NO
REMOVE CODE FROM QUEUE
802
SEND COMMANDS TO A1OCM
803
SEND CODE TO PC
804
805
NEW OUTPUT CMD ?
NO
YES
GET OUTPUT MESSAGE FROM DPRAM
806
SEND COMMANDS TO A1OCM
807
808
NEW TONE CMD ?
NO
YES
SET TONE GENERATOR
809

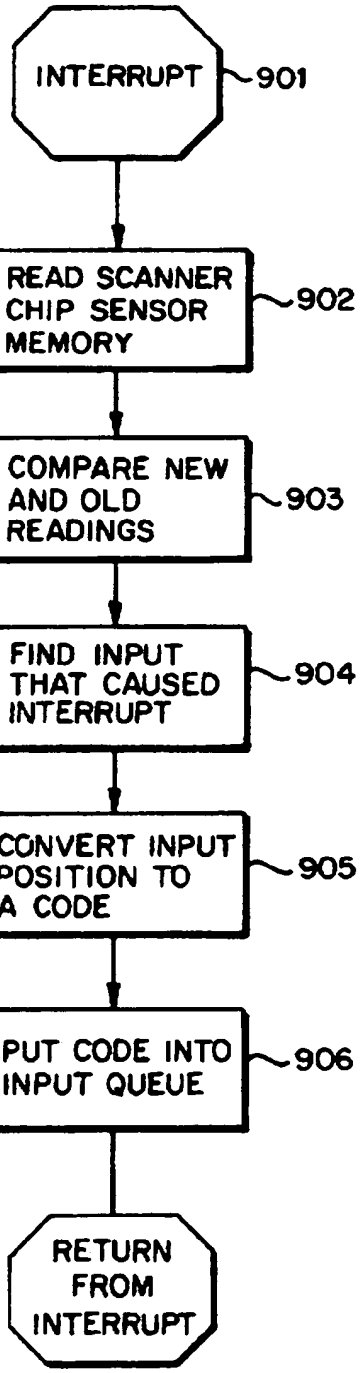

INTERRUPT
901
READ SCANNER CHIP SENSOR MEMORY
902
COMPARE NEW AND OLD READINGS
903
FIND INPUT THAT CAUSED INTERRUPT
904
CONVERT INPUT POSITION TO A CODE
905
PUT CODE INTO INPUT QUEUE
906
RETURN FROM INTERRUPT

FIG. 9

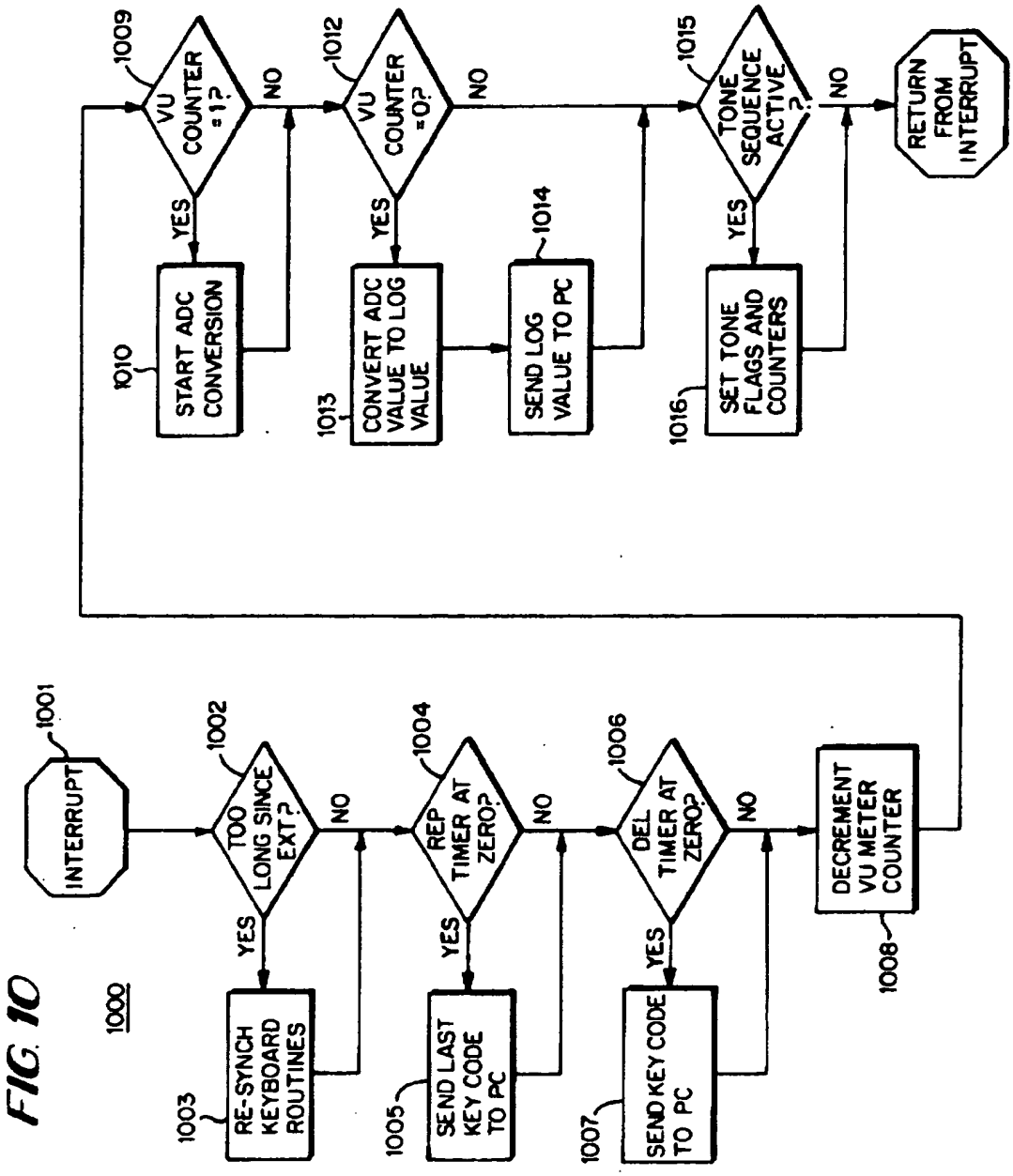

1000
1001
INTERRUPT
1002
TOO LONG SINCE EXT?
YES
NO
1003
RE-SYNCH KEYBOARD ROUTINES
1004
REP TIMER AT ZERO?
YES
NO
1005
SEND LAST KEY CODE TO PC
1006
DEL TIMER AT ZERO?
YES
NO
1007
SEND KEY CODE TO PC
1008
DECREMENT VU METER COUNTER
1009
VU COUNTER =1?
YES
NO
1010
START ADC CONVERSION
1012
VU COUNTER =0?
YES
NO
1013
CONVERT ADC VALUE TO LOG VALUE
1014
SEND LOG VALUE TO PC
1015
TONE SEQUENCE ACTIVE?
YES
NO
1016
SET TONE FLAGS AND COUNTERS
RETURN FROM INTERRUPT

FIG. 10

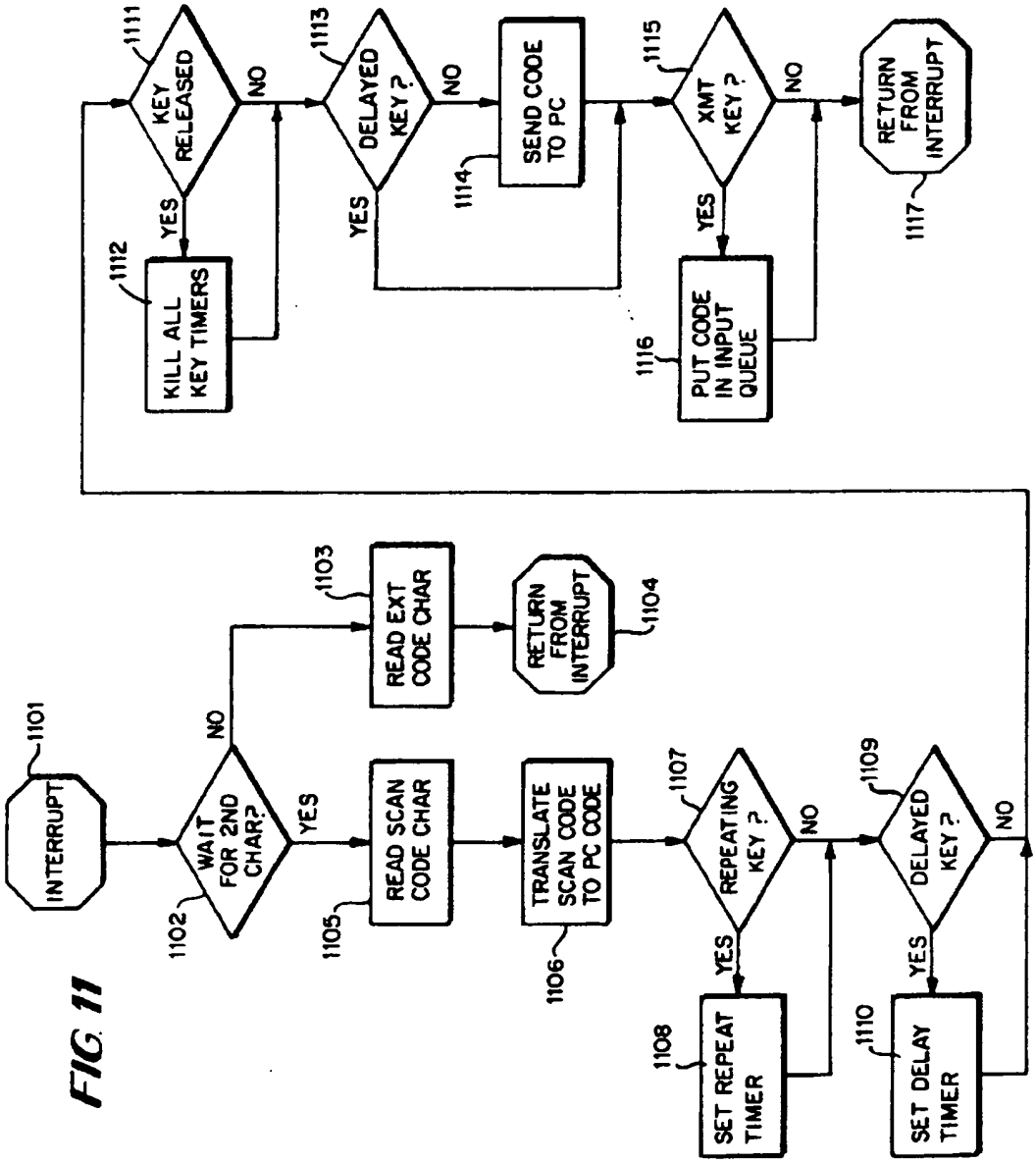

INTERRUPT
1101
WAIT FOR 2ND CHAR?
1102
NO
YES
READ EXT CODE CHAR
1103
RETURN FROM INTERRUPT
1104
READ SCAN CODE CHAR
1105
TRANSLATE SCAN CODE TO PC CODE
1106
REPEATING KEY ?
1107
YES
NO
SET REPEAT TIMER
1108
DELAYED KEY ?
1109
YES
NO
SET DELAY TIMER
1110
KEY RELEASED
1111
YES
NO
KILL ALL KEY TIMERS
1112
DELAYED KEY ?
1113
YES
NO
SEND CODE TO PC
1114
XMT KEY ?
1115
YES
NO
PUT CODE IN INPUT QUEUE
1116
RETURN FROM INTERRUPT
1117

FIG. 11

DISPLAY CONSOLE AND USER INTERFACE FOR MULTISITE RF TRUNKED SYSTEM

RELATED APPLICATIONS

This is a continuation-in-part of Ser. No. 825,689 filed Feb. 22, 1991, now U.S. Pat. No. 5,200,954, issued Apr. 6, 1993.

This application is related to the following co-pending and commonly assigned U.S. patent applications:

U.S. Pat. No. 5,384,854, issued Jan 24, 1995, entitled "Co-Processor Controlled Switching Apparatus And Method For Dispatching Console" filed contemporaneously with this application, in the name of James L. Teel, Jr., Stephen R. Downs, and Charles G. Herndon.

Application Ser. No. 07/658,799 filed Feb. 22, 1991, which is a continuation-in-part application to Ser. No. 07/573,977 entitled "Distributed Multisite Coordination System" filed on 28 Aug. 1990 in the name of James L. Teel, Jr.

U.S. Pat. No. 5,200,954, issued Apr. 6, 1993, entitled "Protocol Between Console And RF Trunking System."

U.S. Pat. No. 5,297,354, issued Feb. 15, 1994, entitled "Data Protocol And Monitoring System For RF Trunking Multisite Switch Global Serial Channel."

U.S. Pat. No. 5,239,538, issued Aug. 24, 1993, entitled "Controller Architecture For RF Trunking Distributed Multisite Switch."

U.S. Pat. No. 5,392,278, issued Feb. 21, 1995, "Distributed Multisite Switch Architecture."

U.S. Pat. No. 5,384,776, issued Jan. 24, 1995, entitled "Audio Routing With A Trunked Radio Frequency Multisite Switch."

The disclosure of each of these related applications is incorporated by reference.

FIELD OF THE INVENTION

This invention relates to user interfaces for computerized telecommunication devices. In particular, the invention relates to a public service radio dispatcher console having a cathode ray tube (CRT) display, customized keyboard, and other user interface devices.

BACKGROUND AND SUMMARY OF THE INVENTION

Radio dispatchers work with radio communication systems that are becoming increasingly complex. The number of radio frequency (RF) channels in these systems and the area that a single system covers have increased substantially.

Since more channels are available, the number of system users has increased. In the past, an individual system would have had one police station or one fire department. Now, a single system handles an entire metropolitan government, including the police department, fire department, ambulances, hospitals, and other governmental services. Instead of only communicating with a small number of users, radio dispatchers can now communicate with hundreds, if not thousands, of system users.

These system users, e.g. mobile radio units, hand-held radios, other consoles and conventional radio base stations, are usually grouped by function into agencies, fleets, and groups. The dispatcher has the ability to communicate with individual users or these functional groups. In addition, the dispatcher can patch users and groups together for a specific call. Similarly, the dispatcher can set up a simulselect call by specifically selecting the groups and individual users to participate in the call.

The coverage of RF systems has been dramatically increased by linking several broadcast sites in a multisite network. Multiple transmitting sites are often necessary to provide RF communications to all locations within a given community. Multiple transmitters can accommodate a rural community covering many square miles. Similarly, multiple transmitters may be used in a city having many buildings that obstruct RF signals. Thus, RF systems are no longer confined to a single transmitter.

The complexity of the system from the view of a dispatcher console is substantially increased by additional channels and multiple transmitters. Instead of broadcasting over a single transmitter on a small number of channels, dispatcher consoles now broadcast over tens, hundreds or even a thousand channels distributed over several transmitters covering a wide area or a large city. A single call can be broadcast from several sites over as many different channels. The dispatcher console must now be informed of the individual transmitters and channels that are being used, and of the status of other transmitters and receivers in the system.

Similarly, the complexity of RF systems is also increasing because of numerous additional operation features that have become available for these systems. Previously, RF systems had basic key and unkey call terminate functions. In untrunked systems, calls to selected individuals and groups were made by selecting the appropriate dedicated channel for that group or individual.

With the advent of digitally trunked multisite systems, RF systems can direct calls to individuals or selected group members covered by different radio broadcast sites. These groups can be formed, disassembled and rearranged by the radio dispatcher. Voice calls can be encrypted for security. Telephone line calls can be made or received through the dispatcher console. Moreover, communications can be in the form of data transmission and are no longer just audio communications.

Dispatchers are facing an increasingly complex RF communications systems. This complexity increases the number of choices to be made by the dispatcher in handling communications. Dispatchers cannot be overwhelmed by the operational aspects of the RF system. The dispatchers must be free to concentrate on the substance of the calls, any one of which may be an emergency call. The added features of a complex RF could become a hinderance to the dispatcher, unless the dispatcher is able to quickly and easily operate the dispatch console. Past dispatcher consoles have not been particularly user friendly.

In the prior art, U.S. Pat. No. 4,961,070 discloses a "Radio Console With CRT Display" that allows channel control windows (CCW), representing selected radio channels, to be moved about the display. The CCWs present status information on individual subfleet communication, such as subfleet identification, caller id and whether the call is busy. The CCWs are moved about the display using a computer-mouse interface which also allows the user to operate a menu at the bottom of the display screen. It is believed that this patent discloses the Motorola Centracom II Plus dispatcher console.

Another prior art dispatcher console is the Console Dispatch Center for the C3™ Series Consoles sold by the assignee Ericsson GE Mobile Communications Inc. The C3™ Console is a microprocessor controlled voice switching system. The dispatcher workstation includes a control panel of dials, buttons and small displays corresponding to

individual call groups, consoles and other units. Both of these prior art systems present the dispatcher with complicated and non-uniformly displayed information.

There is a need for dispatcher consoles that displays call information in an easy-to-comprehend manner, that can be simply configured to suit individual dispatchers. An inventive dispatch console has been developed that is easy for the dispatcher to operate through a customized keyboard and CRT computer display. The dispatch console includes a standard personal computer (PC) having a novel co-processor logic board; a customized keyboard connected to the co-processor board; a CRT; devices for audio communications such as speakers, earphones, microphones and a push-to-talk foot pedal; and an audio switching tower for routing audio between the dispatch console and multisite switch.

The CRT display screen presents information on ongoing communications throughout the RF system and historical information on recently terminated calls. The display is segmented into functional windows. These windows provide information in a uniform and easy to read manner. For example, information on individual communications is shown in an array of communication module windows. Each communication module provides information on a specific call or group such as the caller, volume, and emergency.

The customized keyboard has been tailored so that certain keys are dedicated to specific radio functions. For example, dedicated keys are provided for transmit, communication module control, patch and simulselect calls, and telephone and intercom communications. Common function keys, e.g. F1, F2, are assigned to control various other functions as needed and in conjunction with display menus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a dispatcher console for the present invention;

FIG. 2 is a display screen for the dispatcher console shown in FIG. 1;

FIGS. 3 to 5 illustrate portions of the display screen shown in FIG. 2;

FIG. 6 is a diagram of the customized keyboard shown in FIG. 1;

FIG. 7 is a block diagram of the co-processor board in the personal computer shown in FIG. 1; and

FIGS. 8 to 11 are software process flowcharts showing the operation of the co-processor board illustrated in FIG. 7.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a dispatcher console **10** having a color CRT monitor **12**, a customized dispatch keyboard **14** with 101 labeled keys, audio speakers **16** (in the preferred embodiment each console can have two to twelve speakers), speaker volume controls **18** underneath each speaker, a microphone **20** (or alternatively a headset **21** with volume control **22**), and a foot switch **23** that is a push-to-talk switch. The dispatcher need look only at the CRT monitor to operate the console. The dispatch keyboard provides complete control over the console to the dispatcher. However, push-to-talk switches are provided on the microphone **20** and foot pedal **23** for the dispatcher's convenience.

The speakers, microphone, headset and foot pedal are connected to an audio communications tower **32**. The CRT monitor **12** and an optional standard keyboard **25** are connected to a conventional personal computer **24**. In the preferred embodiment, the personal computer is an AT-class PC computer equipped with VGA graphics, 2 megabytes of RAM, a hard disk and a floppy disk for loading software. The computer uses a proprietary (VRTX) multi-tasking operating system published by Ready Systems, Inc. of Sunnyvale, Calif.

In addition, the computer has an internal co-processor logic board **26** that is further described in U.S. Pat. No. 5,384,854 entitled "Co-Processor Controlled Switching Apparatus and Method for Dispatching Console" and incorporated by reference above. This co-processor board performs the audio and command routing functions necessary for the dispatcher console. The logic board allows a standard personal computer to be converted into a dispatcher console. The customized keyboard **14** is coupled to the logic board and thereby to the personal computer. A standard keyboard **25** may also be connected to the personal computer, but is not necessary for the operation of the dispatcher console.

The dispatcher console **10** communicates with the RF system through a console interface module (CIM) (not shown) in a multisite switch **28**. The multisite switch routes audio (voice) and data signals throughout the RF system. By way of the multisite switch, the dispatcher console communicates with the trunked and conventional radio systems coupled to the switch, to telephone lines connected to the switch and to other dispatch consoles. The dispatch console and CIM communicate using the messages and the protocols described in further detail in U.S. Pat. No. 5,200,954 entitled "Protocol Between Console and RF Trunking Switch" and incorporated by reference above.

Individual dispatcher profiles and entity databases are loaded into the hard drive of the dispatcher console personal computer from the MOM-PC **30** via the console-CIM data link to the multisite switch. The MOM-PC is a central control computer for the RF system and is under the control of the system operator for the entire RF system. The operation of the MOM-PC is described in more detail in U.S. Pat. No. 5,566,388 entitled "RF Trunking Multisite Switch Configuration and Diagnostics Interface" and incorporated by reference above.

The hard disk and PC-RAM in the personal computer stores the user profile that identifies among other things, the dispatcher and the user groups in which the dispatcher participates. The profile contains information regarding the preferred console settings for the particular dispatcher and initial radio settings. As each dispatcher sits down at the console, such as at the beginning of a new shift, the dispatcher calls up the appropriate user profile tailored to that dispatcher. The dispatcher can display the user profile by depressing a function key on the customized keyboard.

The personal computer for the console also stores a database of user entities. Each entity is an individual trunked radio unit (e.g. mobile, portable, or console), a radio talk group, or a conventional radio. There can be several thousands of radio entities in a multisite system. Accordingly, PC-RAM storage is used, instead of ROM, because the entity database may be large and changed in real-time. The entity database includes a record of each entity including the entity ID number, type of entity, e.g. unit and group, home site, home group and an eight character ASCII name.

The console personal computer saves some database updates to hard disk immediately, and some updates are saved only on demand. Thus, the database records are loaded from the disk when an operator shift occurs (dispatcher profile change) or at startup. The MOM-PC database and hard disk can be used for back-up storage to the PC-RAM. If the link breaks between the MOM-PC and the console, the

console will still have relatively-current database information stored on disk.

The dispatcher console relies on the MOM-PC centralized databases to update and change most of its databases. Since the personal computer is linked to the MOM-PC via the mulitsite switch, it has on-line access to these centralized databases. The MOM-PC can send an entire database, or update information for a database such as a single entity updates to modify the entity database. New data base information can be broadcast on demand by the MOM-PC operator or requested by a console, such as when the console comes back on-line after being off-line for a period of time.

The MOM-PC operator may create multiple dispatcher user profiles for each dispatch console. Having multiple dispatcher user profiles allow different dispatchers, e.g. a dispatcher for each work shift, to configure the dispatch console to the individual requirements for each dispatcher simply by calling up the tailored user profile for that dispatcher. The dispatcher user profiles are stored in the dispatcher console. The dispatcher user profiles can be set up and changed only at the MOM-PC.

In addition, each dispatcher console includes an audio input/output communications module (AIOCM) **32** otherwise known as a communications tower that links the audio channels from the CIM of the multisite switch **28** with the speakers, microphone and the foot pedal of the dispatcher console. The communications tower is an audio routing switch for the dispatcher console. The AICOM is controlled via link **27** by the co-processor logic board **26** in the personal computer. The communications tower and logic board are described in more detail in the related U.S. Pat. No. 5,384,854 entitled "Co-Processor Controlled Switching Apparatus and Method for Dispatching Console" and incorporated by reference above.

The overall RF multisite system serves groups of users and individual users. Each user entity, e.g. mobiles, personals, other dispatcher consoles, and conventional base stations in the RF system has an individual identification (Logical ID). Moreover, generally, each mobile radio unit will be a member of one or more groups. The mobile unit is programmed with the group identification of its member group(s) and participates in calls to its group(s). The groups can be organized by, for example, police precincts, fire department engine units, ambulances and hospitals. Most individual users will participate in a call only if the call involves their group. Individual radio units that are members of more than one group can scan for calls or the unit can be set to listen for a particular group to the exclusion of other groups.

Group identification designations are organized in a four-level hierarchy where (i) the particular group is identified as a sub-fleet, (ii) several groups make up a fleet, (iii) one or more fleets make up an agency, and (iv) the total multisite system is all agencies. Most communications are to particular groups. However, the system allows dispatchers to transmit to an entire fleet, agency or system. System wide calls may be restricted so as to be made only from supervisory dispatcher consoles.

As shown in FIG. 2 the dispatcher monitor display screen **12** is divided into window segments. These segments provide discrete work areas on the screen. The segments include an entity listing **40**, a page listing **42**, communications modules **44**, status/prompts/messages **46**, clock **48**, help/call type/menus **50**, and call history **52**. These segments display information in an organized and regular fashion to the dispatcher.

The arrangement of these segments on the screen does not change. However, the information presented in each window segment does change. Thus, the dispatcher can become familiar and comfortable with the arrangement of the segments on the screen. This familiarity allows the dispatcher to pick out desired information quickly from individual windows because the dispatcher learns precisely where this information is displayed by knowing the location of each segment.

One window segment **40** provides a listing of available entities, e.g. site controllers, groups, units, consoles, conventional channels and telephone lines, in the RF system. Another segment **42** of the display lists the pages of communications modules **44** that can be shown. By segregating the communications modules into pages, the number of communication modules that can be displayed is drastically increased and the individual modules can be appropriately grouped by pages.

Communications module windows **44** are arranged conveniently in columns and rows. These modules provide call access to individual groups, entities, consoles and telephone lines in the system. Each communication module is programmed by the dispatcher to represent a particular group, unit, console, channel, line, etc., that is available to the console. To assist in programming the communications module, the available groups, units, consoles, or channels may be displayed in the listing window **40**, e.g. a listing of sites.

FIG. 3 shows a representative communications module **60** from the communications windows segment **44** of the display screen. In the preferred embodiment, each module is allocated seven rows with nine columns per row. The individual fields in each module are: module page and position indicator **62**, the module name **64**, caller name **66**, receiving/emergency call indicator **68**, console transmit indicator **70**, busy indicator **72** showing that another console is transmitting to the module id, encrypted call indicator **74**, patch call designator **76**, simulselect designator **78** and volume indicator **80**. The background color **81** of the module is changed to red to signify an emergency call and to green to signify the select call. The border **82** for the communications module is highlighted when the module is picked by depressing the corresponding module key **114**. A picked module is then modified, muted, selected or changed in volume via keys **118** and **116**.

FIG. 4 illustrates a sample dispatcher profile **84** that can be displayed on the screen. The profile presents the logical id for the dispatcher **85**, volume settings **86**, delay times **87** and other features of the profile. The volume levels can be set such that emergency calls are broadcast louder from the dispatcher speakers than other calls. The dispatcher profile is displayed by depressing keys on the console keyboard.

As shown in FIG. 5, the call history window **52** on the display presents a chronological list of information on recent radio calls. The dispatcher can look to the list of recent calls **91** to determine, for example, who is making calls, which groups have been active, when calls begin and how long they last. The call history information can be even as little as a caller identification. This information allows the dispatcher to better manage the system and the system users.

Normally, the call history operates in a real time mode **92** where the three most recent calls are displayed in the call history window. As a call is terminated, its history comes into view in the call history window. The oldest call displayed is deleted from the window each time another call terminates. The dispatcher can freeze the call history win-

dow to "playback" the previous call. Freezing stops the real time mode at a particular point in time. However, only three calls can be displayed in the call history window at any one time.

The dispatch console stores information on more than the three most recent calls. In the preferred embodiment, information on 32 calls are stored in the console dispatch computer.

The dispatcher can scroll the call history window through the history of recent calls by switching the display to the scrolling mode. The scrolling mode is set up by depressing the help key to display a menu for the function keys. This menu identifies the function key, e.g. F2, that calls up the scroll history mode. When in the scrolling mode, the call history window will display information on any of the stored calls. The call history is moved forward or backward, i.e. scrolled, by operation of the up and down arrow keys on the keyboard. While only three call histories are displayed at any one time, a much larger number of call histories can be displayed through scrolling. The dispatcher can revert back to real time mode on the call history window by depressing the appropriate function key identified in the call history window.

The call history window is organized in a bottom-to-top arrangement with the oldest call at the top and most recent call (denoted by an asterisk) at the bottom of the window. A header **93** at the top of the call history window shows column headings identifying each field in the call histories. The header includes a DATE field that shows the date of the call. The size of the field underneath the DATE header is indicated by the mm/dd/yy symbol. Similarly, the time at which the call began is in the filed under TIME, the TYPE of call indicates whether the call was, for example, a group call, the origin identifies the site or console of the caller, the CALLEE identifies, for example, the group involved in the call, the CALLER is self-explanatory and DUR is the duration of the call. The designation REAL TIME **92** indicates that the call history window is continually presenting the three most recently terminated calls.

The dispatcher console obtains the information needed for the call history window from command messages from the multisite switch to the dispatcher console. For example, upon receipt of a call assigament message, the console takes from the message the caller ID, callee ID, and site origination information and stores it in a circular buffer in the personal computer.

Similarly, date and time information is read from the BIOS timer in the PC computer and also stored in a circular buffer. The circular buffer holds information on many calls, 32 calls in the preferred embodiment. To calculate length of call time, the computer waits for an unkey/drop message and then rereads the BIOS timer. The time from the start of the call is subtracted from the time the call ended to calculate call duration. The digital information corresponding to the calls to be displayed is converted to ASCII data and displayed.

The circular file tracks each call by communications module number. For any period of time, the console may receive several channel assignment and unkey/drop messages for a variety of calls on various channels. Each assignment or unkey/drop message contains an identification corresponding to one of the module identification numbers. The computer matches each message to the corresponding module and stores the information in the appropriate circular buffer. There is one buffer for each module. The call history window tracks all calls regardless of their sequence.

As shown in FIG. **6**, the dispatcher inputs commands to the console through a customized keyboard **14**. The keyboard includes alphanumeric and function keys. The function keys are not all assigned to static functions. Alterable functions keys **102** are assigned varying functions depending upon the operation being performed on the console. The user can perform a specific function on the console by depressing the appropriate function key. A dedicated escape key **104** allows the user to cancel an ongoing operation. Instruction information regarding the operation of the console and each function key is provided through a help window on the display accessed via a dedicated help key **106**.

The alterable function keys **102** are each assigned a default function that applies unless over ridden by a screen displayed menu. These default functions include calling up the user profile screen, changing the user profile because of a shift change, signing onto the computer system, and toggling the call history window. The help key can be used to display a menu of these default function settings.

The dedicated function keys always perform the same function and are grouped with other keys of related functions. For example, the HELP **106** and ESCAPE **104** keys are grouped with the common control functions **108**. In addition, calls to individual units are made through the ICALL SEL and ICALL TX keys, **108**, that allow the dispatcher to enter the unit identifier through the alphanumeric keypad **117**.

As can be seen, the more common functions are assigned dedicated function keys include the establishing of patch **110**, simulselect **112** and telephone/intercom communications **114**; edit control **116** such as paging through screen displays and cursor and position control on the display; muting the console speakers **122**; and emergency condition **120**. A dedicated color coded key **124** sends a push-to-talk command over the selected communications module. The foot switch **23** can also serve this transmit function. Transmissions to any other module is made by depressing the TX key **112** corresponding to the communications module.

Through the use of the customized keyboard, the dispatcher can choose a particular communications module by depressing the appropriate key **114**, e.g. MDL 3, to pick module 3. Once this module has been picked, then the dispatcher can adjust its volume via volume keys **118**, mute the module, **116**, highlight the module for the select speaker (may be headset), modify the module, **116**, or establish (or clear) an emergency condition for the module **124**.

When the module modify key is pressed, a menu screen is displayed assigning new functions to the alterable functions keys **102**. These assigned functions allow the dispatcher to re-program the module to a new unit, group, conventional channel, telephone line, or console.

The co-processor logic board is shown in further detail in FIG. **7**. The heart of the co-processor board is a microprocessor **300** which, in the illustrated embodiment, is a **80C152** microprocessor. Firmware executed by the microprocessor **300** is stored in an EPROM **302**. The microprocessor **300** receives timing signals from a main clock **304**, which also supplies timing signals to a second clock **306**. Pulses from the second clock **306** are utilized by a tone generator **308**, which, in turn, produces the signal TONE for application to the audio tower **32** via an interface cable.

Further included in the co-processor system is a dual port RAM (DPRAM **320**). The DPRAM **320** handles the communication between the microprocessor **300** and the main processor system in the PC over a bus connector **60**.

The co-processor is connected to the audio tower by an interface cable. The co-processor system has a plurality of inverting and diode protection circuits (IDPCs) **330** for conditioning input signals received on the interface cable. The particular input signals applied to each of the IDPCs are shown in FIG. **7**, and are primarily digital input signals, jack sense signals, and push-to-talk (PTT) signals.

The conditioned signals received from the audio tower **32** are applied to an appropriate one of three octal tri-state buffers **332** (shown as buffers **332A**, **332B** and **332C**). The buffers **332** are connected by a buffer data bus **334** and a buffer control bus **336** to a buffer scanner **338**. In the illustrated embodiment, the buffer scanner **338** is a keyboard scanner chip.

The co-processor logic board also includes an analog-to-digital converter (ADC) **350** for converting a signal VU PC received from the VU meter amplifier circuit **222** (in the audio tower **32**). Prior to application of the VU PC signal to the ADC **350**, the VU PC signal is conditioned by a conditioner circuit (CC) **352**. The conditioner circuit **352** includes protection diodes and an operational amplifier.

Selected pins of the microprocessor **300** are connected to apply signals to the audio tower. In this respect, pins **P5.0–P5.3** are connected to form a bus for carrying a SELECT signal; pins **P4.1** is connected to carry a STROBE signal; pin **P4.0** is connected to carry a DATA signal; and pins **P6.0–P6.5** are connected to carry an ADDR signal. The SELECT, STROBE, DATA and ADDR signals are conditioned by respective conditioning circuits **354**, **356**, **358** and **360**, respectively, prior to application to the interface cable. The conditioning circuits **354**, **356**, **358** and **360** essentially are inversion (with pull-up) and diode protection circuits.

In addition to the EPROM **302** and the DPRAM **320**, the co-processor logic board includes random access memory (RAM) **370**. The microprocessor **300** is connected by a co-processor data bus **372** to the ADC **350**, the buffer scanner **338**, the RAM **370**, the EPROM **302**, and the DPRAM **320**. The microprocessor **300** is connected by a co-processor address bus **374** to the RAM **370**, the EPROM **302**, and the DPRAM **320**. Further, in conventional manner, the microprocessor **300** is connected by a co-processor control bus **376** to the ADC **350**, the buffer scanner **338**, the RAM **370**, the EPROM **302** and the DPRAM **320**.

As indicated in FIG. **1**, the co-processor keyboard **14** is connected to the co-processor. A signal from the co-processor keyboard is applied to a keyboard input protection circuit **382** prior to application to the microprocessor **300**. The keyboard input protection circuit **382** provides inversion and diode protection functions.

The software routines performed by the co-processor board monitor the keyboard, scan inputs and other inputs for command messages. FIG. **8** shows the over all main processing loop. In step **801**, the process checks whether its input queue is empty. If an input is in the queue, then the message code is retrieved, step **802**, and the commands necessary in view of the message are issued to the audio tower (AIOCM) step **803**. Similarly, the code is stored in the DPRAM **320** and an interrupt is sent to the PC microprocessor in step **804**.

If the input queue is empty (see FIG. **9**), step **801**, or once the queue code has been acted upon **803** and the PC interrupted **804**, a check is conducted for an output command, step **805**. If the message number for the retrieved command with the processed indices for the DPRAM **320** are not equal, then a new command exists, step **806**, and it is retrieved from the DPRAM. The commands necessary in view of DPRAM message are issued to the AIOCM, in step **807**. Finally, a check for a new tone command is conducted in step **808**. If a new tone is needed, then the tone generator is set to sent the tone for a predetermined period of time (duration timers are set) in step **809**. Once these checks for commands have been completed, another command check begins.

As shown in FIG. **9**, the scanner chip monitors the external inputs. When an input change is detected, the scanner interrupts the main microprocessor in the co-processor board in step **901**. The microprocessor then reads the scanner memory to determine which input has changed, in step **902**. This determination is done, in step **903**, by comparing the current status of the scanner memory with the last scanner memory state that is stored and, thus, available to the microprocessor. Thus, multiple inputs can occur while the microprocessor is running other programs. The inputs will be properly processed when the scanner interrupt detection routine is conducted.

Once the input (or inputs) that caused the interrupt is determined, step **904**, the microprocessor generates the code corresponding to that input in step **905**. The code (or codes) is then stored in the input queue in step **906**, and the interrupt routine completed.

In this way, the main processing loop (FIG. **8**) picks up the input through a code in the input queue and sends the code to the input processing routines.

An external clock **304** provides pulses to the internal counter in the co-processor board's microprocessor. This internal counter interrupts the microprocessor, e.g. every 10 milliseconds, to trigger a timer service routine. This routine checks flags, decrements active software timers, and checks for active software timers that have been decremented to zero. Depending on which active software timer reaches zero, the control logic of the co-processor board issues a key code, updates the VU meter value being displayed in each communications module on the screen, or changes flags and timers related to tone generator sequences.

As shown in FIG. **10**, the co-processor board microprocessor is interrupted by its internal counter in step **1001**. The interrupt calls up the timer interrupt processing routine **1000**. The microprocessor first checks whether too much time has elapsed since receiving the last extended (EXT) code, and, if so, re-synchronizes the keyboard routines in steps **1002** and **1003**. If step **1002** yields a yes, then the flags are re-synchronized to be ready for the next code which is expected to be an extended code. The EXT code is the first byte of a 2-byte code sent to the co-processor logic board **26** each time a key is depressed on the keyboard **14**.

If the repeat timer for a key depression is at zero, step **1004**, then the last key code is resent to the personal computer in step **1005**. The dispatcher user will hold down a key to signal that a particular key function is to be repeated, such as scrolling. Similarly, when the emergency declare key **120** is depressed, a delay timer, e.g. 1 sec., starts in order to delay the issuance of the key code to the personal computer. This delay ensures that the emergency key is held down for a full second and not inadvertently depressed. In steps **1006** and **1007**, the key code is issued when the delay timer reaches zero.

The displayed VU meter is updated regularly by the co-processor. The co-processor decrements a counter each time it runs its timer interrupt processing routine, in step **1008**. When the VU counter equals one (1), step **1009**, the co-processor starts an analog-to-digital conversion (ADC) from data indicative of the volume level on the select and

I/O input. Thus, when the VU counter reaches zero, step 1012, the co-processor converts the new ADC value to a logarithmic (LOG) value, step 1013, and sends the log value to the personal computer, step 1014. The personal computer then updates the displayed VU meter.

Finally, the timer interrupt processing routine checks whether the tone sequence is active, step 1015, and, if so, sets the tone flag counters, step 1016. These flags are used to turn tones on/off and to change the generator frequency for warble tones, when the timer expires, the flags are set so that the tone sequence continues for a predetermined number of cycles. Then, the co-processor returns from the timer interrupt routine until 10 milliseconds later when it is again interrupted by the logic board's internal clock counter.

The customized keyboard is connected directly to the co-processor logic board. When a key is pushed or released, the keyboard sends a two-byte character sequence to the co-processor logic board. The first character byte is an extended code (EXT) that identifies whether the depressed key is in a normal or ALT mode, or whether the key has been released. The second character byte is the key scan code that identifies the key on the keyboard. Based on the particular key codes, the key may be set up with a repeat or delay counter.

As shown in FIG. 11, the co-processor is interrupted when it receives the first character byte from a key press or release, in step 1101. If the co-processor is not waiting for the second byte of the code, step 1102, then the co-processor reads the extended code, step 1103, and returns from the interrupt, step 1104. The extended code is stored, and the co-processor waits for the second byte interrupt.

If a second character byte is expected, step 1102, then the scan character code is read from this second byte, step 1105, and translated into PC code, in step 1106. If a repeating or delayed key is depressed, then a repeat timer or delay timer is set as is appropriate, steps 1107 to 1110. Similarly, if the key is released, step 1111, then these key timers are terminated, step 1112.

Unless a delay key has been depressed, step 1113, the translated PC code is sent to the personal computer, in step 1114. The code from a delayed key is sent after the delay timer expires. If the transmit key is depressed, step 1115, its code is loaded into the input queue, step 1116, and then acted upon when the co-processor next executes its main loop processing routine. Finally, the microprocessor returns from its interrupt routine, step 1117.

The invention has been described in connection with what is presently considered to be the most practical and preferred embodiment. The invention is not limited to the disclosed embodiment. It covers various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. In a public service radio system including a multisite switch, a dispatcher console operatively coupled to said multisite switch, said console comprising:

a personal computer including a co-processor board, a display screen, and a keyboard directly connected to said co-processor board,

said co-processor board communicating command messages from said computer to an audio switching tower, said tower routing audio communications between said multisite switch and audio input/output devices at said console;

wherein said display screen is segmented into windows including a window of communication modules, said communication modules presenting information regarding individual system groups, said communication modules having a module background color distinctive of a background color for said display screen, the module background color of an individual communication module changes when a predetermined key or key sequence is activated on said keyboard.

2. A dispatcher console as in claim 1 wherein said module background color changes to red in a predetermined communication module when an emergency key or key sequence is activated on said keyboard.

3. A dispatcher console as in claim 1 wherein said module background color changes to green in a select communication module when a predetermined key sequence is activated.

4. In a public service radio system including a multisite switch, a dispatcher console operatively coupled to said multisite switch, said console comprising:

a personal computer including a co-processor board, a display screen, and a keyboard directly connected to said co-processor board,

said co-processor board communicating command messages from said computer to an audio switching tower, said tower routing audio communications between said multisite switch and audio input/output devices at said console,

wherein said personal computer stores historical information on numerous terminated audio communications in said system, and

wherein said display screen is segmented into windows including a call history window, said call history window presenting historical information partially listing said numerous terminated audio communications, said call history window being operable in a real time mode whereby historical information on the most recent terminated calls is presented, and operable in a scrolling mode whereby historical information is presented in a scrolling manner on other of said numerous audio communications.

5. A dispatcher console as in claim 4 wherein said call history window presents the elapsed time of terminated communications and wherein said elapsed time is the time between a call initiation message and a call termination message as received by said console from said multisite switch.

6. In a public service radio system including a multisite switch, a dispatcher console operatively coupled to said multisite switch, said console comprising a personal computer including a co-processor board, a display screen having a window of communication modules, and a keyboard directly connected to said co-processor board, a method for transmitting from said console comprising the following steps:

a. selecting an individual communication module as the select module by depressing a dedicated key corresponding to that individual communication module and then depressing a module select key;

b. transmitting an audio signal over the multisite system to a group corresponding to the select module by activating a transmit key; and

c. transmitting an audio signal over the multisite system to another group other than the select group by depressing a transmit key dedicated to a communications module for that another group.

7. A method as in claim 6 wherein the step of transmitting to a group corresponding to the select module is initiated by depressing a key on a microphone at the dispatcher console.

8. A method as in claim 6 wherein the step of transmitting to a group corresponding to the select module is initiated by depressing a pedal on a foot activated switch.

9. In a public service radio system including a multisite switch, a dispatcher console operatively coupled to said multisite switch, said console comprising:

a memory storing historical information on numerous terminated audio communications in said system, and

a display screen operatively coupled to said memory, said display screen being segmented into windows including a call history window, said call history window presenting historical information partially listing said numerous terminated audio communications, said call history window being operable in a real time mode whereby historical information on the most recent terminated calls is presented, and operable in a scrolling mode whereby historical information is presented in a scrolling manner on other of said numerous audio communications.

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